JANUARY 1, 1932—VOL. CLIII.

THE ENGINEER.

A Seven-Day Journal

The New Cunard Liner.

THE statement in a letter by the Prime Minister to Mr. Will Thorne, published in the daily papers on Wednesday last, concerning the suspension of work on the new Cunard liner, lends weight to the views we expressed in our leading article of December 18th. The trouble with the ship, Mr. MacDonald says, is not to get her built, but to get the company to believe that when she is built she can be run with some chance of paying her way. There would appear, Mr. MacDonald further states, to be no difficulty in getting money for building, if there were any prospect at the moment of getting the interest repaid and the loans refunded. The general impression seems to be that work on the liner will not, in any case, be resumed until about Easter. In an official communication from the Cunard Company, issued shortly before Christmas, reference was made to Sir Percy Bates' speech to the shareholders at the last annual meeting, in which the reasons for the ship's construction were given. Sir Thomas Bell has also recently stressed the prudent care and forethought which was bestowed on the design of the new liner before her keel was laid, and the belief of the owners that the new vessel was essential in order to gain the blue riband of the Atlantic and to maintain Britain's prestige, not only as the greatest shipbuilding country, but as the greatest engineering country in the world. In response to further inquiries regarding the suspension of work on the new liner, the Cunard Company officially stated on December 30th that it had nothing to add to its circular to the shareholders of December 10th and to the statements already issued.

Financing the French Line.

As recorded in our last issue, the Bill advocating further State support for the French Line was sent back to the Finance Committee of the French Chamber for reconsideration. Shortly before Christmas the revised Bill was adopted by the Chamber, and it is understood that the French Government is to give the company provisional support until the Bill, if it is finally passed by the Senate, becomes law. The Bill provides for a loan of £2,400,000 on the security of the company's property, including the ships, wharves, buildings, &c. It gives a majority to the State nominees on the board of directors and further calls for an inquiry into the acts of the recent management. All transactions over £4000 are, under the Bill, to be subject to State control. That part of the original Bill relating to a proposed increase in the subsidy for carrying mails to £240,000 has been omitted in the revised Bill, as this provision is closely associated with the question of the construction of the new super "Ile de France" at Penhöet, which matter is to be discussed more fully at a later date. With regard to the suggestion which is attributed to the French Minister of Marine, that if the Cunard Company would give up "No. 534," the French Line would give up its super liner, the Cunard Steamship Company has officially stated that it has received no communication in this connection, either from the French Government or the French Line. It points out, further, that although the last Cunard express liner was the "Aquitania," commissioned in 1914, the French company has since added to its fleet the "Paris" in 1922 and the "Ile de France" in 1926, while the new liner comparable in size and speed with the new Cunard liner is now well advanced in construction.

New Bridge at Calcutta.

ON Tuesday last, December 29th, 1931, a new bridge was formally opened at Calcutta by Lord Willingdon, the Viceroy of India, accompanied by Lady Willingdon, who herself gave the signal for the first train to pass over the structure. The bridge, which is to be known as the Willingdon Bridge, crosses the Hooghly to the north of Calcutta, and it provides two lines of railway and two roadways. Certain technical particulars regarding it are given elsewhere in this issue under the heading of "Some Bridges of 1931," but it may here be said that between 60 and 70 per cent. of the steel employed was obtained from the Tata Steel Company, at whose Tatanagar Works it was manufactured, while all the spans were fabricated near Calcutta by Braithwaite and Co., Ltd. India, in fact, claims it to be a truly Indian bridge, for though Messrs. Rendel, Palmer and Tritton, of Westminster, furnished the designs, most of the material used was Indian, as was also the method of erection, which was supervised by engineers of the East Indian Railway Company. As part of the opening ceremony the Viceregal party first crossed the bridge in a special train, and then returned by motor-car on one of the roadways.

Agricultural and General Engineers.

ON Wednesday last, December 30th, the ordinary general meeting of Agricultural and General Engineers, Ltd., took place in London. Mr. G. E. Rowland, the chairman of the company, presided, and gave a short history of the merger proposals and the economies which it was thought could be expected from such means. He then dealt with the suggestions made by a committee of the Board and the proposals of the minority directors, which were referred to in our last week's Journal note. Mr. Rowland then announced that it had been decided to have a full and complete investigation into the affairs of the company and to invite Sir Gilbert Garnsey to co-operate with Lord Plender in this work. The terms of the inquiry are:—to review (*a*) the present financial position of the company and its associated companies and the possible need for further reorganisation of the share capital of the company; (*b*) the past and present earnings of the company and its associated companies and their estimated future earnings; (*c*) the past and present management of the company and its associated companies, the policy followed, and the causes which have given rise to the disappointing results; (*d*) future policy and management, and any other point or points which may be considered necessary relating to the conduct of the business from its inception. As the auditors reported that although the audit had been completed, fuller consideration of the accounts of the parent and subsidiary companies was necessary, it was decided that an adjourned meeting should be held within two months.

Large Transformers for Barking.

A LARGE order for transformers has recently been placed with the Hackbridge Electric Construction Company, Ltd., of Walton-on-Thames, Surrey, in connection with the extensions which are being made to the Barking station of the County of London Electric Supply Company, Ltd. Although the order includes a large number of station transformers with designed outputs up to 10,000 kVA, the main item of interest in it is a set of two transformers, each having a B.E.S.A. rating of 93,750 kVA at three-phase, 50 cycles, with a transforming ratio of 12,500 to 33,000 volts. The continuous output of these transformers which is permissible at an air temperature of 30 deg. Cent. will be, however, 103,125 kVA, which will make them the largest power transformers under construction. They will be of the forced-oil, water-cooled type and a very high efficiency is expected in service. It is satisfactory to know that British electrical manufacturers can lead the way in the design and manufacture of highly important electrical apparatus of this type.

Work on the G.W.R. for 1932.

A BIG programme of work will be started by the Great Western Railway Company this year. Among the many improvement schemes is the replacement of the last two of Brunel's famous wooden viaducts. They are those at College Wood and Ringwell respectively, on the Falmouth branch, both constructed in 1862–1863, and their disappearance will be regretted by many admirers of that great engineer's work. About £885,000 is to be spent by the company on new rolling stock, to be built at Swindon, which includes ten new 4–6–0 "Castle" class, twenty 4–6–0 "Hall" class, and sixty tank locomotives. Projected improvements to stations at Paddington and Cardiff were recorded in a note on this page some weeks ago, while many other stations are to be brought up to date by lengthening of platforms or the provision of further waiting-rooms, centralised signalling schemes, or extra sidings. Three hundred and seventy miles of permanent way are to be relaid, steel sleepers being used in many places. The building of two new steamers for the Fishguard-Rosslare cross-Channel services will cost £350,000. The schemes mentioned above are all additional to work already in hand. The total expenditure will exceed £1,500,000.

A Message to the Electrical Industry.

IN a New Year's message to the electrical industry the Minister of Transport, Mr. P. J. Pybus, says:—"Once more the consumption of electricity in the towns and densely populated areas shows a gratifying increase, but much more progress remains to be made. Under the auspices of the Central Electricity Board standardisation of frequency and the great scheme of the co-ordination of the generation of electricity have opened the way to a great forward step in the electrification of Great Britain. The real harvest, however, will be reaped when in due course electricity is more generally available to a larger range of householders. This further development, together with continued progress in the standardisation of industrial and domestic appliances, is obviously a most urgent and necessary step. Parliament has authorised the imposition of import duties on certain electrical appliances, and I am sure that manufacturers of this country will take full but proper advantage of these provisions. In their own interests, and in that of the country at large, they will no doubt appreciate the necessity of offering the consumer a sound article at a reasonable price."

Wellington Harbour Floating Dock.

ON Monday last, December 28th, news reached this country that the 17,000-ton floating dock built by Swan, Hunter and Wigham Richardson, Ltd., for the Wellington Harbour Board had on that day safely reached its destination after the longest tow on record. The dock is of the sectional box, self-docking type and has an overall length of 584ft. and a width of 117½ft. Seven months ago it was launched from the Wallsend shipyard in three portions, which were later assembled and completed. The dock left the Tyne on July 15th in the charge of two tugs owned by L. Smit and Co., of Rotterdam. The route taken was *vid* Gibraltar, the Suez Canal, the Malacca Strait, the Torres Strait between New Guinea and Queensland, and then down the west side of the Great Barrier Reef. The dock, it may be recalled, reached Tandjong Priok, Java, about the middle of October, her progress having averaged about 100 nautical miles a day. The speed of the remainder of the voyage was not so great owing to adverse currents and gales. It is a matter of warm congratulation to all concerned that the long and hazardous voyage of 13,500 miles was safely completed nearly six weeks before the originally estimated date.

Road Congresses.

THE Minister of Transport, Mr. P. J. Pybus, has agreed to accept the office of Honorary President of the British Organising Committee of the Permanent International Association of Road Congresses. This Association, whose headquarters are in Paris, comprises in its membership the Governments of fifty countries, including Great Britain, as well as large numbers of County Councils, Corporations, &c., and makes the arrangements for International Road Congresses which are held every three or four years, the most recent having taken place at Washington, U.S.A., in 1930. The British Organising Committee, representing as it does the important organisations and institutions in this country which are concerned with highway finance, traffic, road construction, &c., makes itself responsible for promoting British interests not only while the Congress is being held, but during the lengthy preparatory stages which these international gatherings involve.

Aeronautics in 1931.

No. I.

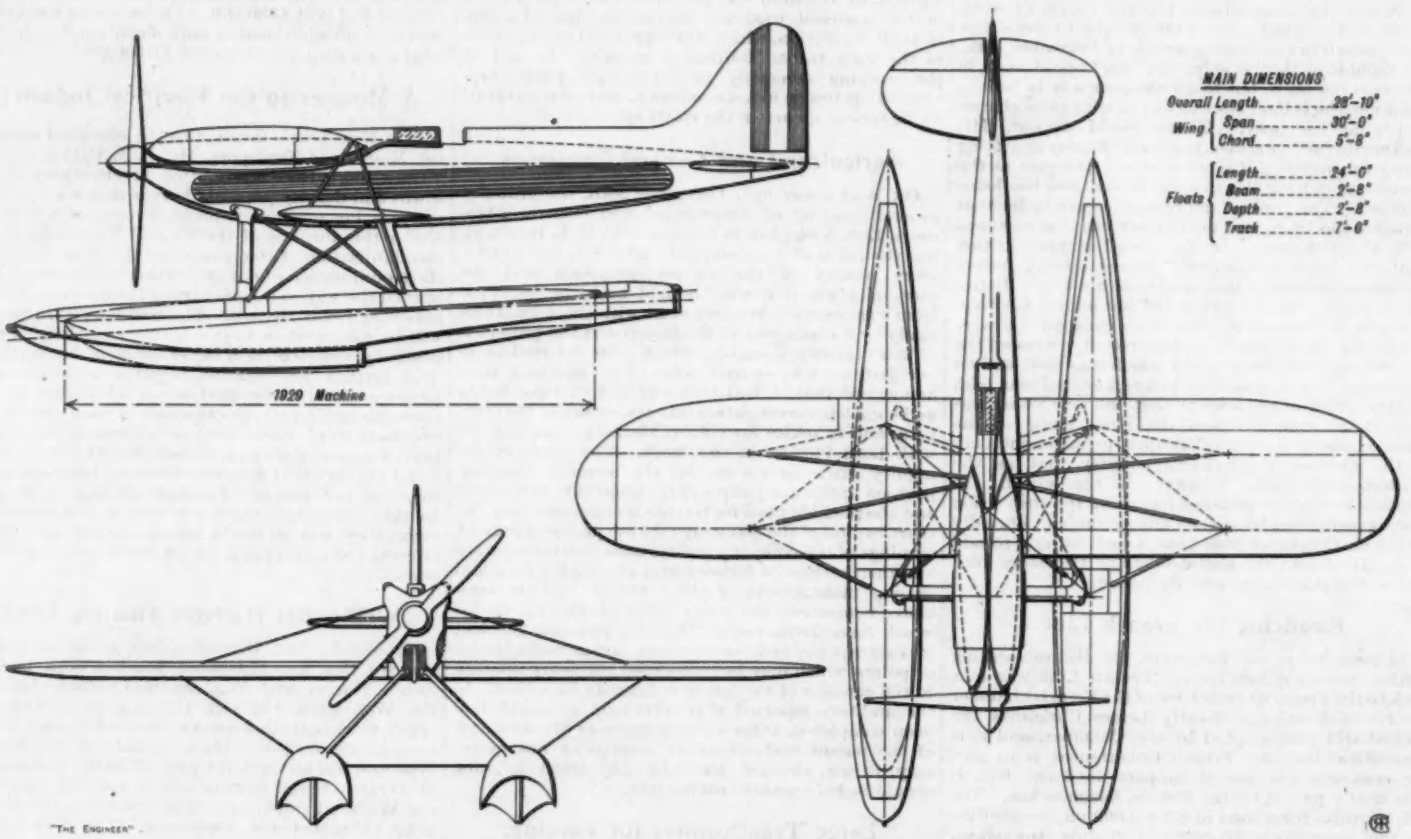
AT first sight it may be a little surprising to learn that during a year in which most branches of engineering, including some of the oldest, were hard put to it to survive, the aeronautical section, practically the youngest of them all, was, if not exactly prosperous, at least comfortably employed, and showed unabated enterprise and progress. Doubtlessly, this anomaly is in part to be accounted for by the virile spirit which marks everything and everyone connected with the air. In largest measure, however, it is to be explained by the fact that the British aeronautical industry, fostered by a wise Government policy, has now become firmly established, and has achieved for itself a very high international reputation.

From the outset the Air Ministry, departing from the general policy of most other Government Departments, has left the manufacturers and designers of the technical equipment which it requires full opportunity to develop their individuality. Beyond indicating its requirements in broad terms and laying down specifications for materials, testing and performance, it has encouraged British aircraft and aero-engine manufacturers to develop their own ideas in design and construction. Within the Ministry's organisation there is no body analogous to the Royal Corps of Naval Constructors. It possesses directors of technical development, of scientific research, of inspection, and of equipment, but it has no officer corresponding to the Director of Naval Construction at the Admiralty. It undertakes the repair and reconstruction of damaged machines, and at Farnborough it carries out a considerable amount of full-scale experimental work. But it neither designs nor builds its service machines or engines. That work it leaves to the industry. By following this policy it has succeeded in establishing within a comparatively short time a loyal, widely diffused, and highly skilled body of manufacturers co-operating with it and with each other, but separately proud of their individuality. With full scope given to initiative, the aeronautical industry of this country has attained a height of technical achievement which is unsurpassed by that of any other country. Alike in engines, aircraft, and accessories, British manufacturers have acquired an international prestige, and are benefiting from it during the present lean times.

Until within the past few years, the British aeronautical industry was almost wholly dependent upon the orders which it received from the British Government. That condition no longer prevails in anything like the same measure. For the first eleven months of 1931 our exports of aircraft and aircraft parts amounted in value to over £1,700,000. During the same period our aeronautical imports were valued at only £39,000, from which sum nearly £16,000 should be deducted for re-exports. The balance of trade is therefore overwhelmingly in our favour in the aeronautical industry. The full story is not, however, told by the import and export figures. British aircraft and aero-engines are now being manufactured under licence in many foreign countries, and even in branch factories which the parent companies have themselves established abroad.

In connection with our foreign trade in aircraft, it should be recorded that the Air Ministry which has, in effect, a prior lien on all new machines and engine developments originating in this country, is exercising its autocracy in a liberal spirit. It does not restrict manufacturers to exporting military machines which have been obsolete in the Royal Air Force for some considerable time. On the contrary, some of the foreign contracts executed during the year—such as those fulfilled by the Fairey, Hawker, Westland, and Vickers companies—were for machines which are still being supplied to and used by the Royal Air Force in large numbers.

Of all the events of the year in the air, the chief in its reaction upon the country's international prestige was the winning outright on September 13th of the Schneider seaplane trophy. Almost at the last moment France and Italy announced that they would be unable to compete. This country was therefore left alone in the contest. Two new Supermarine Rolls-Royce machines had been prepared for it, and on one of them Flight-Lieut. J. N. Boothman succeeded in completing the prescribed course over the Solent at an average speed of 340·08 miles an hour, as compared with the late Flight-Lieut. Waghorn's speed of 328·63 m.p.h. in 1929. On September 29th Flight-Lieut. G. H. Stainforth, flying the winning Schneider Trophy machine, established the world's record speed of 408·8 m.p.h. on a straight course over Southampton Water. The winning of the Trophy for the third time in succession gave its permanent possession to this country, and brought the contest to a close after an existence dating from 1913.



SUPERMARINE-ROLLS ROYCE S 6 B SCHNEIDER TROPHY SEAPLANE

Some British Aircraft of the Year.

As usual, in reviewing the activities of British air craft builders, we have been compelled to confine our attention to machines concerning which the regulations of the Air Ministry permit the publication of particulars. In this connection we notice a certain amount of increased expedition on the part of the Ministry in transferring machines from the secret to the publication lists, a step which the manufacturers have for some time been urging.

The Supermarine Aviation Works (Vickers) Ltd.—First place in the record of the activities of the Supermarine Aviation Works at Southampton must be given to the Vickers-Supermarine Rolls-Royce S 6 B machines constructed for the 1931 Schneider Trophy Contest. The design is illustrated herewith by means of a general arrangement drawing, on which the main dimensions are set forth. A material alteration was made in the conditions governing the contest. Previously the manœuvring and navigability tests had been carried out on the day preceding the speed test. Last year it was decided that the preliminary trials should be gone through immediately before the machines started to fly over the speed course. It followed therefore that the machines had to be provided with sufficient oil and fuel capacity to enable them to undertake the preliminary and the speed tests without replenishing their supplies. This fact, combined with the use of a Rolls-Royce "R" engine developing 2300 H.P. at sea level in place of the Rolls-Royce "R" engine of 1929 which developed 1900 H.P., naturally resulted in the S 6 B machines showing slightly increased dimensions all round, and a somewhat greater fully loaded weight than the S 6 machines with which the contest was won in 1929.

With 135 gallons of petrol and 15 gallons of oil, and a pilot weighing 160 lb., the fully loaded weight of the S 6 B machine is 5995 lb. Of that total, 1635 lb. is accounted for by the weight of the engine and 232 lb. by the weight of the air screw. The principal modifications incorporated in the design as a result of the new conditions or of the experience gained with the 1929 type are to be found in the oil, water, and fuel systems, in the floats, and in the controls. The oil-cooling arrangements had to be improved in order to cope with the increased horse-power of the engine. After leaving the engine the oil is forced along the coolers on the sides of the fuselage, and passes into a tank in the fin. Thence it passes through a filter into a return or suction cooler on the underside of the fuselage. Less difficulty was experienced in transferring the heat from the cooler to the air than in transferring it from the oil to the surface of the cooler. As a result of extensive research by the firm and at the Royal Aircraft Establishment, the efficiency of the coolers was improved by as much as 40 per cent. This result was achieved by fixing small vanes in the oil ways. The type and pitch of the vanes had to be carefully chosen in order to avoid excessive restriction in the flow. Ultimately, a system was evolved which gave a temperature drop of 60 deg. between the oil outlet and the oil inlet. That figure, it is stated, has never before been approached in any aircraft.

In order to keep the new engine at the correct temperature, it was necessary to dissipate about 40,000 B.Th.U. per minute from the radiator surfaces. The efficiency of the radiators in the wings could not be appreciably improved, and therefore the problem resolved itself into providing increased radiator surface. The solution was found by converting the top sides of the floats into radiating surfaces. A new type of header tank, with a steam separator, was designed to prevent any loss of cooling water from the system.

As in the 1929 machines, the fuel is carried in the floats. From them it is delivered by engine-driven pumps to a small pressure tank in the fuselage. On a steeply banked turn the acceleration may reach five or six times the value of gravity and under it the fuel pumps cease to operate. The small pressure tank contains just sufficient petrol to keep the engine running during a turn and is replenished by the pumps when they resume working after the turn. Much more fuel is carried in the starboard tank than in the port tank, with the object of balancing the reaction torque from the engine, which is very high, particularly at starting. The effect of the full engine torque is to transfer a load of about 500 lb. from one

float to the other. Were this torque not counteracted it would probably be impossible to get the machine off the water, because of the yawing effect which would arise from the heavy loading of the port float. A good deal of trouble was caused in the early stages by the fuel transferring itself from one float to the other in such a way that while one tank was nearly empty, the other remained full. This difficulty was in the end overcome by the use of a special venting system in the overflow pipes from the header tank.

The floats were entirely redesigned. They are longer than in the 1929 design, but following experiments at St. Albans and at the National Physical Laboratory it was found possible to produce a form

SHORT "KENT"—ENTRANCE GANGWAY

with decreased air resistance per unit of volume and possessing improved take-off characteristics. Constructionally difficulties were encountered because of the fact that water cooling surfaces had to be provided, as stated above, on the whole of the top side of each float. The water is received nearly at the boiling point and under the effect of its temperature the radiators expand nearly half an inch. To prevent the skin of the floats buckling an elastic framework construction had to be provided to take up the expansion.

In the S 5 machines produced for the 1927 contest slight flutter of the ailerons was experienced if the controls were allowed to become slack. Calculations showed that at the increased speed of the S 6 B machines there would be a possibility of trouble in this respect. To obviate it, mass balances were fitted both to the ailerons and to the rudder.

When the machine is travelling at its maximum speed the ordinary small inaccuracies of construction manifest themselves in air loads on the fin and tail plane which have to be corrected by the application of a load at the control column and the rudder bar. Since the fin and tail plane are built into the fuselage structure it is not possible to compensate these loads by adjusting the rigging. To overcome the difficulty the elevators and rudders were fitted with small flaps at their trailing edges, which were adjusted to the angle necessary to give the machine the correct trim when the pilot removed his hands and feet from the controls at top speed. The flaps are only a few square inches in area, but are stated to have proved perfectly effective in use.

The control of the machine on the water presented a curious feature. The new metal air screws designed by the Fairey Aviation Company, Ltd., were 8ft. 6in. in diameter, as compared with 9ft. 6in. in the 1929 machines. It was found impossible to get the machine off the water with these air screws because at an early stage of the take-off the machine swung violently to port in spite of a full starboard rudder. With an air screw 8ft. 10in. in diameter it was only just possible to get off under very favourable conditions. With the old 9ft. 6in. screws the take-off was easy and, indeed, an improvement on the take-off of the 1929 machines, the reason for the improvement, no doubt, residing in the improved float design. Eventually screws of 9ft. 1½in. were adopted.

Apart from the design and construction of the Schneider Trophy machines, the Supermarine Company produced the well-known twin-engined "Southampton" flying boat in a new form, namely, fitted with Rolls-Royce engines. It is stated that the change has very considerably improved the aerodynamic qualities of the machine. Good progress was made with the six-engined civil monoplane flying boat to carry forty passengers, which, as we recorded a year ago, the company is building to the order of the Air Ministry. This machine will be driven by six 900 H.P. Rolls-Royce engines and will have a span of 174ft. It is being constructed largely of stainless steel. Another interesting machine produced by the company is the three-engined all-metal "flying yacht," of which we give an illustration on page 14. This aircraft is now undergoing development trials. It is of monoplane construction, the short lower wing-like projections being primarily intended as stabilisers to take the place of the customary wing tip floats.

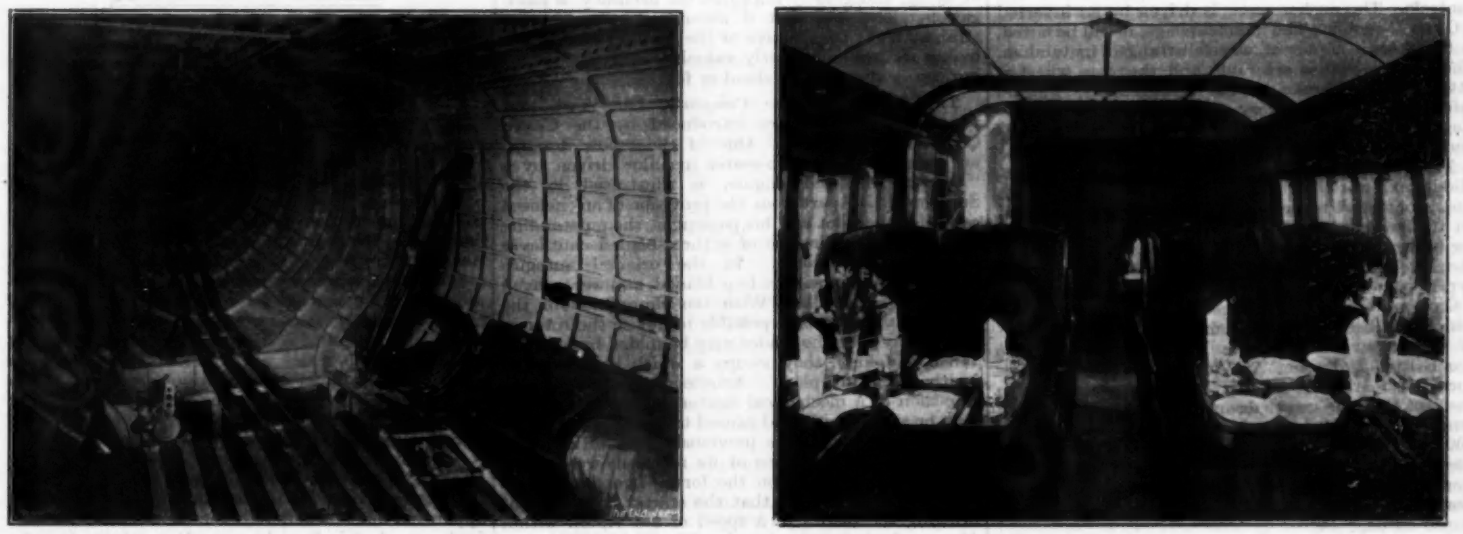
Short Brothers, Ltd.—The activities of Short Brothers at Rochester during the year were of very great interest. On the productive side the chief events were the posting of three service versions of the "Calcutta" flying boat to form a squadron at Basrah, and the delivery of three "Kent" class four-engined commercial flying boats to Imperial Airways for operating the Brindisi-Alexandria and Brindisi-Sea of Galilee sections of that company's Indian and African routes. As regards new design, the principal item of the year's work was the completion of a very large flying boat to the order of the Air Ministry. This machine, it is said, will be the largest flying boat in the world, with the exception of the "Dornier Do. X." This new machine, it is understood, has been built primarily for very high-speed and long-range work with great load-carrying capacity. If it were built for commercial purposes it would have a pay load of 23,000 lb., as compared with 7600 lb. for the "Kent" class working on the same routes. It should be ready for trials early this year. A development of this machine is being contemplated, and much work has been done towards the production of a flying boat to act as a "depôt ship" to it. Not content with these developments, the firm has devoted a considerable amount of wind tunnel and tank research work to the evolution of a small machine having a range of 3000 miles in still air and capable of carrying sufficient paying load to make the Transatlantic crossing a commercial possibility. Several new types of spar and wing construction have been evolved and are shortly to be tested, and it is believed that two of them are likely to exercise a revolutionary effect on the design of cantilever monoplanes.

For many years past, certainly since 1920, when they produced the celebrated "Silver Streak," Messrs. Short have in a noted degree aimed at the creation of machines which could unhesitatingly be called engineering structures. To what extent they have now realised that object may be gathered from the accompanying engravings illustrating the interior of the hull of the "Kent" class of flying boat to which we have referred above. A general view of one of these three machines—known as the "Scipio," "Satyrus," and "Sylvanus"—will be found in the Supplement. They are each driven by four "Jupiter" geared engines developing a normal output of 555 H.P. per engine. The upper plane has a span of 113ft. The machine has a height of 28ft. and an overall length of 78ft. 5in. Fully loaded it weighs 32,000 lb., of which 13,100 lb. represent the weight of the equipment, crew, fuel and paying load. A crew of three is carried and accommodation is provided for fifteen passengers. In addition to 60 lb. personal luggage per occupant the machine can carry over 4000 lb.

SHORT "KENT"—PILOTS' COCKPIT

offmails or other load. The cruising speed is 105 m.p.h. and with 410 gallons of petrol in the tanks the machine has a cruising range of 450 miles.

Chief structural interest centres in the hull. In a flying boat seaworthiness is as important as airworthiness. Not only must the hull be capable of withstanding prolonged exposure to the sea, but it must be free from any tendency to "porpoise" during the taking-off period, and must possess a low air resistance. The hull of the "Kent" class is of the two-step type. Above the water line it is formed of anodically treated duralumin, while the under-water sheeting is of stainless steel. The wing tip floats, it may be noted, are constructed entirely of duralumin. In the bow of the hull there is a mooring compartment, immediately behind which the two pilots sit side by side in an enclosed cockpit. Behind the starboard pilot accommodation is provided for a wireless telegraphy operator, and immediately aft of the wireless room is the mail compartment measuring about 6ft. in length and height and about 7ft. in breadth. Farther aft is the passengers' cabin, which has a length of about 14ft., a breadth of nearly 9ft., and a height of 6ft. 6in. Communication between the cockpit and the cabin is established by a gangway on the port side. Entrance to the machine is obtained through a door at the centre of this gangway, the passengers turning aft and the crew going forward. Lavatory accommodation is provided aft of the cabin on the starboard side, while on the port side there is a steward's compart-



SHORT "KENT" CLASS FLYING BOAT—INTERIOR OF HULL LOOKING AFT, AND PASSENGERS' CABIN

ment. Still further aft is a luggage space of about 350 cubic feet capacity, entrance to which is gained through a separate hatch. The upholstery of the cabin is of the Short pneumatic type and can be converted in emergency into life-saving apparatus.

The four engines are arranged in line and are mounted in monocoque nacelles which are supported at the front and rear by single vertical duralumin tubes. This method of mounting the engines is claimed to be simple and to possess great torsional strength. A lubricating-oil tank of 16 gallons capacity is fitted in each nacelle. The petrol supply is drawn from three tanks, each holding 240 gallons, situated in the upper centre plane. In calm air the tankage is sufficient for a flight of well over 800 miles. A Bristol gas starter in one of the nacelles is employed to start all four engines. At the after end of the hull there is a quick-release hook under the control of the pilot, which enables the engines to be run up at the buoy before the anchorage is slipped.

Westland Aircraft Works.—More than five hundred machines of the "Wapiti" type have now been supplied to the British, Australian, Hedjaz, South African and other air forces, and in addition a considerable number has been built under licence in South Africa. The "Wapiti" machine is adaptable to many purposes. It is in use on Army co-operation duties in India, at the Photographic School at Farnborough, and at the Armament and Gunnery School at Eastchurch. As a training machine it was supplied during the year to the Auxiliary Squadrons with the rear gunner's cockpit converted into a pilot's cockpit and fitted with a second set of controls. The machine attracted considerable interest from some of the South American air forces during the course of the Buenos Aires Exhibition. It was demonstrated both as a land plane and as a twin-float seaplane. In the second-named form it was left moored out for long periods in all weathers and was exposed to a great variety of water conditions, from the mud of the River Plate to the very salt water of Bahia Blanca. On dismantling no trace of corrosion of any duralumin or steel part was found, a source of trouble of common occurrence in floats and hulls in South America. This satisfactory result is attributed to the extensive use made of the anodic process which is applied to all the duralumin parts of the machine. Experimental and development work on the "Wapiti" is being continued at Yeovil.

A number of "Wessex" three-engined cabin monoplanes was completed during the year. By fitting the machine with a seven-cylinder "Genet" major engine instead of the smaller five-cylinder type its top speed has been increased from 108 m.p.h. to 118 m.p.h. The rate of climb has been correspondingly improved and height can be maintained on any two engines at 6000ft. The cabin can be arranged purely for the carriage of goods or with four, five, six, or seven seats.

The Hill "Pterodactyl" tailless machine in the two-seater cabin design illustrated in the Supplement was tested during the summer and was publicly demonstrated at the Royal Air Force Display. Much successful experimental flying has since been carried out on the machine, and it is reported to have proved itself very manœuvrable and responsive to the controls. The pusher screw is driven by an inverted "Gipsy" engine. The undercarriage, it will be noted, is fitted with a pair of wheels arranged in tandem. The front wheel is steerable and the rear wheel is fitted with a brake. This arrangement, we are informed, has proved very successful. The manœuvring of the machine on the ground is extremely simple and is not affected by rough places or bumps.

The Fairey Aviation Company, Ltd.—The Hayes, Middlesex, works of the Fairey Aviation Company, Ltd., continued to be employed throughout the year on the production of machines exclusively intended for service purposes. Little can be said concerning the developments which took place. Among the new types produced during 1931 was the Fairey "Gordon," a two-seater general purpose machine which has been evolved from the "Fairey III. F" of which several hundreds have been supplied to the British and other Air Forces. The chief difference between the "Gordon" and its parent lies in the fact that the newer design is fitted with an Armstrong-Siddeley "Jaguar Major" air-cooled engine of 500 H.P., in distinction to the water-cooled engine used in the older type. Several R.A.F. Squadrons were equipped with "Gordon" machines during the year. A photograph illustrating the type is reproduced on page 14.

An important event in the firm's history was the delivery during the year of a large consignment of Fairey "Firefly" II. M and Fairey "Fox" II. M machines to the Belgian Government. This contract is one of the largest ever received for British aircraft from a foreign government. In addition to supplying these machines, the company during the year opened a factory at Gosselies, Belgium, for the production of the latest types of service machines.

Of one machine produced at the Hayes works during the year, the Fairey long-range monoplane, fairly full information can be given. It was designed and built by the firm to the order of the Air Ministry, and is illustrated in a Supplement, It is proposed to employ it shortly on an attempt to secure the world's long-distance record by a non-stop flight from England to Cape Town. As a navigation test, it has already completed the first non-stop flight to Egypt. It is almost indentical with the earlier machine which, after attempting a non-stop flight to India, was destroyed by crashing into a mountain in North Africa on a subsequent attempt to fly without stopping to the Cape.

The wings and tail planes are pure cantilevers, the only external bracing wires being those supporting the fin. The thickness, chord, and angle of incidence of the wing section varies from the root to the tip, and tests have shown that the lift coefficient is very high, and develops no sudden stall after the angle corresponding to the maximum lift. A special system of patented internal bracing obviates twisting of the wings during manœuvring, a common trouble in cantilever monoplanes with fabric wing covering. The wheel track of the undercarriage is unusually wide, in order to give the machine stability on the ground. The wheels are mounted on roller bearings to assist taking off, and fairings are applied to them to reduce their drag in the air. The machine has a span of 82ft., and a length of 48ft. 6in. Power is supplied by a Napier "Lion" engine of almost the normal service type. More than 1000 gallons of fuel are carried in tanks in the wings. From these tanks the petrol flows to a collector tank in the cabin, whence it is mechanically pumped to the engine. Improved venting arrangements are provided in the fuel system to minimise the loss of fuel by evaporation and surging. The cabin is totally enclosed, and is fitted with "Triplex" windows, which can be cleaned from the inside. The second pilot or navigator sits in a deck chair in the cabin and can see downwards and sideways through the windows. A drift sight can be fitted in the floor of the cabin, and in the roof an opening is provided for taking sextant readings. A short-wave wireless transmitting—not receiving—set, working on 33·71 m. is carried.

Unlike the earlier machine, the new one is fitted with an "automatic pilot" which has been under development for a number of years at the Royal Aircraft Establishment. This device derives its sense of direction from a gyroscope driven continuously by compressed air. The gyroscope controls the action of pneumatic cylinders, which, in turn, govern the movement of the rudder and elevator. The sensitiveness of the device is stated to be such that it can detect and instantly correct a deviation of a fraction of a degree of the machine from the set course. Facilities are provided to enable the pilot to change the set course in order to correct for variations in the wind or other disturbing factors. Without disturbance of the automatic control, the trim of the aircraft can be altered in order to make it climb or dive to a new altitude. It is stated that after trials on R.A.F. machines of widely different types, varying from a small two-seater single-engined machine to large twin-engined bombers and flying boats, the device has been proved to be very trustworthy, and to be capable of controlling a machine in flight far more precisely than is possible with the most skilled human pilot. It has already been tested on flights lasting several hours, and extending up to 400 miles in length under all weather conditions. Its advantages are that it relieves the pilot completely of the fatigue of flying, and greatly improves the accuracy of navigation. The fact that it maintains very accurate straight flight irrespective of the weather conditions, makes its use particularly valuable when the visible horizon is obscured by cloud or fog.

The Cierva Autogiro Company, Ltd.—Two new types of autogiro were introduced by the Cierva Company, of London. One of these new designs, an enclosed cabin, two-seater machine driven by a "Gipsy" inverted engine, is illustrated in the Supplement. Apart from the provision of an enclosed cabin for the pilot and his passenger, the outstanding development is the use of a three-bladed cantilever "windmill" or rotor. In the original autogiro machines the rotors were four-bladed, and were stayed by means of cables. With the elimination of the bracing, it has become possible to devise the rotor in such a way that the blades may be folded backwards. When so folded, they occupy a width less than the width of the tail plane. Another new feature is the provision of a mechanical starter, whereby the rotor may be set spinning and caused to develop lift sooner than it would do if, as previously, the initiation as well as the maintenance of its rotation, were made dependent entirely upon the forward motion of the machine. It is stated that the starter is capable of bringing the blades to a speed of 200 r.p.m. within 45 sec. An internal expansion brake is fitted to stop the movement of the rotor after the machine has alighted. The machine is of composite wood and metal structure, and has been constructed to the Cierva Company's designs by the de Havilland Aircraft Company, Ltd. It is fitted with dual control, the main control being from the front seat. Bendix brakes are fitted to the chassis wheels. The rotor has a diameter of 34ft., but when its blades are folded the span of the machine is reduced to that of the fixed wings, namely, 19ft. 6in. The top speed is about 120 m.p.h., and the cruising speed about 100 m.p.h. At sea level the machine can climb in the fully loaded condition at the rate of 600ft. per minute. Its practical "ceiling" is about 10,000ft. The run required for taking off is stated to be only a quarter of that required by an equivalent aeroplane.

The second type of autogiro produced during the year is similar to that described above, except that the pilot and passenger's seats are not enclosed, while the engine is a 100 H.P. "Genet" Major. In the fully loaded condition this machine weighs 1450 lb., and has a top speed of 102 m.p.h. Its minimum speed flying level is 25 m.p.h. At sea level its average length of take-off run is 30 yards. In the absence of wind it can descend along a flight path inclined at 40 deg. with a velocity the vertical component of which is 13ft. per second.

We learn that the company now has in hand a very light single-seater sports model to be constructed by the Comper Aircraft Company, Ltd., and to be fitted with a Pobjoy engine. It has also begun the design of a large passenger-carrying autogiro machine.

Vickers (Aviation), Ltd.—A very noteworthy product of the Weybridge works of Vickers (Aviation), Ltd., was the four-engined type 163 biplane, which we illustrate on page 14. This machine is designed to serve either as a night bomber or as a troop carrier and is stated to be the largest of its class that has been built. It is driven by four Rolls-Royce "Kestrel" supercharged engines arranged in two tandem pairs. Each engine develops 480 H.P. at 2250 r.p.m. and maintains its power up to 11,500ft. As a bomber the machine carries a service crew of five, together with a heavy armament load. As a troop carrier it takes a crew of four and a load of twenty-one men in the cabin. The machine has a length of 66ft. 9in. and a height of 22ft. 4in. The wing span is 90ft., but the wings can be folded to reduce the span to 44ft. 6in. The fully loaded weight is 25,700 lb. The structure of the machine is all metal, principally of duralumin, with wing and other coverings of fabric. The ailerons on the upper wing are of the Frise type. The two-wheeled undercarriage is fitted with Vickers' oleo-pneumatic shock absorber legs and with hydraulically operated brakes. The tail wheel is mounted to provide a castor action and is of the oleo-sprung pattern.

During the year successful trials were carried out with the "Vildebeest" machine fitted as a twin-float torpedo-carrying or bombing seaplane. This machine, which is also produced as a landplane bomber or torpedo carrier, is illustrated on page 14. It is fitted with a Hispano-Suiza engine in the example represented, but other makes of engine can be adopted. As a torpedo carrier its total weight is 9100 lb. So loaded it has a ground level speed of 132½ miles an hour and a landing speed of 61½ miles an hour. With 124 gallons of petrol it can cruise for 4·6 hours at a speed of 106 m.p.h. It can climb to 11,000ft. at an initial rate of 600ft. per minute. During August the machine fitted with a Bristol "Jupiter X." engine was adopted for the Royal Air Force. Fitted with a Hispano engine it is being built in Spain under licence from Messrs. Vickers for the Spanish Naval Air Service.

The Vickers "Viastra" twin-engined civil monoplane, which we dealt with in our review last year, is reported to have given a good account of itself. Two machines of the type were supplied to West Australian Airways, Ltd., for service on the Perth-Adelaide mail route.

(To be continued.)

Electrical Engineering in 1931.

No. I.

Introductory.

IN continuation of a movement which started at the beginning of 1930, there was a sharp increase in unemployment in the electrical industry during the first quarter of 1931, and from April onwards heavy electrical work was stabilised at a low level. According to the B.E.A.M.A. statistics, the total quantity of new orders received during the first nine months of the year for generating plant and equipment amounted to no more than one-half of the orders obtained during the corresponding period of 1930, and much of the work carried out during the twelve months under consideration was in connection with orders received during the previous year. The frequency standardisation scheme gave rise to a fair number of orders from areas where change is in progress, whilst orders for "grid" transformers represented the main work done by some of the electrical firms. The market for lighter domestic apparatus did not suffer to the same extent as that for heavy electrical machinery. Notwithstanding the general industrial depression, Great Britain was the only country to show a substantial increase in its generation figures during the year.

Never has the work of electrical engineers been so well brought to public notice as it was during the period under review. The Faraday celebrations, and particularly the Faraday Exhibition held at the Royal Albert Hall, attracted a great deal of public attention. Similarly the flood-lighting demonstrations in London and elsewhere did much to stimulate interest in electrical illumination. The publication of the Weir report on main line railway electrification was another noteworthy event, although just at present there does not seem to be much prospect of any new main line work being put in hand. On the technical side one of the most noteworthy developments was the advance made by mercury arc rectifiers, which now seem to hold out the possibility of being

suitable for converting D.C. to A.C. as well as *vice versâ*, and for changing frequency.

Progress of the National power scheme during the period under review was satisfactory. Out of a total mileage of 2930 miles required for primary transmission lines wayleaves for 2490 miles were secured at the end of the first week in last December, leaving only 440 miles mainly in areas recently adopted, namely, South-West England and South Scotland. All wayleaves have been obtained for Central England, Mid-East England, East England, North-East England, and Central Scotland, and only a few miles remain to be secured in North-West England, whilst in South-East England, where, owing to large buildings and industrial activities around London the greatest difficulties are met with, only 49 miles of wayleaves remain to be obtained. For secondary transmission lines, 745·5 miles out of a total of 1071 were obtained by the end of the first week of December. Since December 31st, 1930, wayleaves obtained for both primary and secondary lines increased by 1500 miles. The mileage of lines actually constructed is now 2157, primary lines accounting for 1666 miles, and secondary lines for the remainder. The increase since the end of December, 1930, was in excess of 1500 miles. The primary and secondary lines in actual operation in the first week in December, 1931, totalled 840 route miles, the areas in which large-scale operations have been begun being Central Scotland, South-East England, Central England and Mid-East England.

The value of the contracts approved by the Central Electricity Board for the construction of the National Power Scheme is now almost £22,000,000, and South-East England accounts for the largest sum—about £7,000,000. Next comes North-West England, with

TABLE I.

Scheme area.	Approximate total mileage of routes.	Miles of wayleaves obtained.		Total miles of towers erected at November 30th, 1931.	Lines in operation or being used as standby as at November 30th, 1931.	
		At December 31st, 1930.	At November 30th, 1931.		Route miles.	Circuit miles.
Primary Transmission Lines :—						
Central Scotland	240·6	240·6	240·6	240·6	240·6	296·5
Southern Scotland	230·0	—	105·6	—	—	—
North-East England	91·3	70·0	91·3	91·3	—	—
North-West England	313·0	231·2	305·7	190·1	—	—
Mid-East England	322·7	198·8	322·5	288·0	69·6	70·6
Central England	397·5	320·4	397·5	332·3	76·1	83·9
East England	138·1	14·3	137·9	87·0	—	—
South-East England	520·5	301·9	467·5	353·0	172·4	205·8
South-West England	676·0	14·0	394·2	62·5	—	—
Total, Great Britain	2929·7	1391·2	2462·8	1644·8	558·7	656·8
Secondary Transmission Lines :—						
Central Scotland	11·6	—	11·6	—	—	—
Southern Scotland	143·3	—	8·1	8·1	—	—
North-East England	89·6	30·2	89·6	66·9	23·4	39·7
North-West England	263·8	129·0	213·1	112·5	72·9	137·1
Mid-East England	201·1	97·6	199·4	155·2	39·9	39·9
Central England	18·0	17·8	18·0	18·0	15·7	31·3
East England	24·0	—	14·1	—	—	—
South-East England	209·9	71·9	170·0	107·3	104·9	155·0
South-West England	110·0	8·5	15·2	13·2	15·7	31·3
Total, Great Britain	1071·3	355·0	739·1	481·2	272·5	434·3
GRAND TOTAL	4001·0	1746·2	3201·9	2126·0	831·2	1091·1

slightly more than £3,000,000, Central England with about £2,500,000, and Mid-East England with about £2,400,000. If the progress made during 1931 is maintained, it is expected that the construction work will be completed by the end of 1932 or the beginning of 1933. The accompanying table shows the progress made in the construction of the grid up to November, 1931.

In areas where standardisation of frequency is essential, notably North-East England, Central Scotland and Central England, the work is being carried out with increased rapidity and about £7,750,000, or more than 40 per cent. of the entire estimated cost of standardisation, has already been sanctioned by the Central Electricity Board. These figures represent contracts for the installation of new plant or the conversion of old plant placed by local supply undertakings. At the end of November, 1931, the Board was supplying purchased electrical energy to more than eighty undertakings. Outdoor sub-stations have been put into operation in various parts of the country, and a good example of one of these sub-stations, *i.e.*, that at Hams Hall, is shown in our Supplement.

The station is of the high double bus-bar type and supplies the Central England system, which is interconnected with the grid schemes throughout the country. It is arranged in nine bays and comprises two 45,000-kVA transformers, nine 132-kVA three-phase oil circuit breakers and thirty-six 132-kVA rotary isolating links. The transformers were built by the British Electric Transformer Company, while the whole of the switchgear was supplied by the General Electric Company, Ltd. The steel structure carrying the rotary isolating links and outgoing transmission lines was supplied by the Horseley Bridge and Engineering Company, Ltd. Each of the oil circuit breakers is capable of breaking a load of 1,500,000 kVA and is operated by means of solenoids which are energised from a 110-volt battery. The rotary isolating links, which are used for changing over from one set of bus-bars to the other, are interlocked, so that it is impossible to operate them while the transmission line in question is on load. The transformers are protected against overload and leakage, and the protective gear for the latter purpose is designed so that it will only come into operation in the event of a fault occurring within the transformer itself. Protection of the transmission lines is provided by the G.E.C. biassed-beam relays in accordance with McColl patents and the Reyrolle ratio balance system. Apart from the switchgear, the G.E.C was responsible for the illuminating arrangements of the station.

Unfortunately, the Electricity Commissioners' returns do not cover the period under review. Some of the statistical returns in fact for the year 1930–31—the year ended March 31st, 1931, in the case of Local Authorities in England and Wales; May 15th, 1931, for Scottish Local Authorities, and December 31st, 1930, for companies—are still outstanding; but the following approximate figures of plant installed are not without interest :—

	kW.
Total capacity installed up to end of year 1930–31	6,953,000
Total capacity of plant installed at end of previous year	6,600,000
Net increase	353,000

This increase is made up by the installation of 423,000 kilowatts of new plant, and the shutting down of 70,000 kilowatts of old plant. The Commission are unable to state the total amount of plant installed at the end of 1931, but the following approximate figures have been computed from the monthly fuel returns rendered to the Commissioners :—Stations closed down during 1931, 23; new stations put into commission, viz., Clarence Dock, Liverpool, and the small station of the Buckie Corporation, 2; existing stand-by stations recommissioned, 2, and stations which had previously been operated on a non-statutory basis, but which became part of authorised undertakings during the year, 5. The stations closed down during 1931 were as follows :—

Owner.	Station name.
Local Authorities—	
Bromley Corporation	—
Chichester Corporation	—
Walton-on-the-Naze Urban District Council	—
Companies—	
Central Sussex Electricity, Ltd.	Haywards Heath
Cirencester Electric Supply Company, Ltd.	—
Culm Valley Electric Supply Company, Ltd.	Bradninch
East Anglian Electric Supply Company Ltd.	Stowmarket
East Cornwall Electricity Supply Company	Tor Point
East Devon Electricity Company, Ltd.	Exton, Honiton, Sidmouth, Woodbury
Electric Supply Corporation, Ltd.	Chelmsford
Fife Electric Power Company	—
Frinton-on-Sea and District Electric Light and Power Company, Ltd.	Brightlingsea
Hawes Electric Lighting Company, Ltd.	Gayle Mill
Ormskirk Electric Supply Company, Ltd.	—
St. Austell and District Electric Light and Power Company, Ltd.	St. Austell
Sherborne Electric Supply Company, Ltd.	—
Shropshire, Worcestershire and Staffordshire Electric Power Company, Ltd.	Church Stretton
Wallingford and District Electric Supply Company, Ltd.	—
Warminster Electric Supply Company, Ltd.	—
Wickford and District Electricity Supply Company, Ltd.	—

New Power Stations.

In their eleventh annual report, that for the year April, 1930, to March 31st, 1931, the Electricity Commissioners refer to four steam generating stations in the course of construction—the Battersea station of the London Power Company, Ltd., the Barking extension of the County of London Electric Supply Company, Ltd., the Ironbridge station of the West Midlands Joint Electricity Authority, and the Clarence Dock station of the Liverpool Corporation, now in operation. The present position of the Battersea station is, perhaps, best explained by the pictures which we publish in our Supplement. The river works, including the coaling jetty, the circulating water tunnels, cable tunnel and screening plant, were completed during the year, and good progress was made with the coal store excavation and the erection of conveyor towers and bridges. An idea of the skeleton work for the towers and bridges can be gained from one of the pictures to which we have alluded, where one end of a bridge section is to be seen in the foreground resting on the wagon tippler foundations. Ultimately, these bridges and towers will be encased with cement plaster work. Progress was also made in the direction of enclosing the boiler-house in which six boiler units are being erected. The general view of the interior of the turbine room is from a photograph taken from the 150-ton overhead travelling crane. The stators of the alternators are being wound in a temporary winding shop that has been erected in the station. In the background of the picture the L.P. casing of the first turbo-alternator is to be seen in place. Work on the north and south gable ends is progressing rapidly, and another illustration shows north gable end. The switch-house has been completed and the work of erecting the switchgear has been begun. The remaining picture shows the work in progress on the main flue gas treatment flue.

As regards the Barking extension, the information given in the Electricity Commissioners' eleventh report may be brought up to date by saying that the switch-house is now complete and the switchgear is in course of erection; part of it should be in service at an early date for interconnection with the Central Electricity Board's "grid" sub-station. Good progress was made with the erection of the steel work for the boiler-house and turbine-house buildings; portions of the boiler structures are being erected. In connection with the river works, consisting of the jetty and pump-house, the excavations are down to the final level and the concreting work has been begun. With the exception of certain auxiliary items, contracts for the whole of the plant required have been placed, and the manufacture of the steam-raising and generating plant is in hand at the makers' works.

Turning now to the Ironbridge station, which is shown in its present stage of construction in Figs. 1 and 2, good progress was made with the civil engineering work. A steel bridge designed to carry a load of 20 tons with a span of 165ft. across the river Severn, and with three auxiliary flood spans of 55ft., was completed, and is now being used for regular traffic on to the site. The inter-relations of the rail level of the G.W.R. line on the site and the necessity of lifting the essential parts of the building above flood level necessitated a considerable amount of earth and embankment work, all of which was completed during the year. The buildings consisting of an administrative block facing the river and containing the main switchgear, stores, workshop, offices and control room, are now practically complete, and the building work of the turbine and boiler-rooms is also in an advanced stage of construction; in fact, the whole of the plant and equipment should be ready for testing at an early date. The Central Electricity Board's "grid" lines from Ironbridge to Ocker Hill and from Ironbridge to Wolverhampton, over which the current generated at the new station will be transmitted to the Midlands, should be ready to take a supply from the station in the late spring or early summer.

At the Clarence Dock station of the Liverpool Corporation three of the four boilers have been put into service, and the fourth has been lighted for drying out purposes and lagging. The first turbo-alternator has been running on commercial load since July up to a maximum load of about 40,000 kW, and it regularly generates about half the total units of the undertaking. The second turbo-alternator, which is primarily intended to serve as a standby to the first set, is almost ready for running. In general it may be said that this new station—the only large station put into service during the year—is complete and is in regular operation. Another new station, which should soon be completed, is the Dunston extension of the Newcastle-upon-Tyne Electric Supply Company.

Generating Plant.

Some of the work in hand at the Heaton Works of C. A. Parsons and Co., Ltd., were described in our issue of November 20th, when we gave an account of a visit we paid to those works in company with engineers from various parts of the country. The most important machines then in evidence were the three 50,000-kW, 1500 r.p.m. turbo-generators for the Dunston station of the Newcastle-on-Tyne Electric Supply Company, Ltd. As they are designed for interstage re-superheating of the steam which is supplied to the H.P. end at 600 lb. per square inch and at a total temperature of 800 deg. Fah., the turbines are of special interest. After expanding down to approximately 120 lb. pressure in the H.P. cylinder, the steam is returned to the boiler-house for

reheating to the initial temperature of 800 deg. Fah., and it is then expanded in a single flow low-pressure cylinder to 29in. vacuum. Each of the alternators generates at 13,500 volts, and the pressure is raised in transformers to 66,000 volts, the switching being done on the secondary side. From the closed circuit system employed for ventilating the main alternator, air is taken for the ventilation of the totally-enclosed exciter, slip rings, and auxiliary motors, and in order to prevent grit or dust being carried into the main alternator air circuit "Viscous" filters are employed.

Two 36,000-kW, 6600-volt turbo-alternators for Copenhagen were completed during the year, and the first machine has recently been running at the works under steam. These turbines are two-cylinder, tandem, reaction machines, with a double-flow, low-pressure cylinder, and are designed for a total steam temperature of 850 deg. Fah. The two exhausts of the low-pressure cylinder discharge into an inverted condenser, which is arranged so that only one condenser shell is necessary for each unit. A 30,000-kW, 3000 r.p.m., 6600-volt, two-cylinder, tandem, reaction turbo-generator set, with a double-flow low-pressure cylinder, was completed, and erected in the Hackney Borough Council electricity works. Two 18,750-kW, 2000 r.p.m., 11,000-volt turbo-generators were also put into service in the Lots-road power station of the London Electric Railways, and another Parsons unit of similar size is at present under construction for this station. At the Brimsdown station of the North Metropolitan Electric Supply Company, where the first Parsons 33,000-volt alternator was put into service, 3½ years ago, a second 25,000-kW machine, wound for the same voltage, is now being installed. The alternator is driven by a Parsons 3000 r.p.m., reaction, two-cylinder, tandem turbine, coupled to a double-exhaust, single-shell condenser of the inverted type. For the Pretoria Municipality, South Africa, a 15,625-kW, 3000 r.p.m., 12,000-volt set was built and tested, the condenser in this case being of the single-exhaust, inverted type.

Several geared uniplane turbo-alternators, as shown at the Machinery Exhibition, were completed, and many others, we are told, are on order. These units are particularly suitable for power stations abroad in areas where it is difficult to obtain skilled labour for the erection and operation of standard sets. They are built in sizes ranging from 250-kW to 3000-kW, and one of the machines under construction is designed for the extraction of steam at a pressure of 30 lb. per square inch. A 15,000-kW, single-cylinder turbo-generator set—the largest in the world running at a speed of 3600 r.p.m.—completed a continuous run of over twelve months in May of 1931.

Among the most important turbo-generators built by the Metropolitan-Vickers Electrical Company were two 71,500-kVA, 1500 r.p.m. sets for the Liverpool Clarence Dock power station. The machines generate at 7250 volts, and the pressure is stepped up in three-phase transformers, each generator and transformer forming a complete unit. A special chamber for the transformer is formed in the foundation block of the generating set, and the need for a separate transformer house is avoided. The work for the Montevideo power station was completed, and the first section of the station is now in operation, the whole of the work from the commencement of the site to the starting up of the plant having been carried through in sixteen months. Ultimately, the station will have a capacity of 120,000 kW. The two machines that have been installed have each an output of 25,000 kW at a speed of 3000 r.p.m. Tests carried out on the two Metro-Vick 35,000-kW turbo-alternators at the Deptford West power station of the London Power Company showed highly satisfactory results, and a third set is now in course of erection. Two sets, corresponding to the 40,000-kVA turbo-alternator that has been in operation in the Victoria Falls Power Company's station for some time, are in course of manufacture for the same undertaking. Among other sets running at 3000 r.p.m. are two 31,250-kVA M.C.R. machines for Kyushu, Japan, and some smaller units, of 25,000-kVA capacity and less, were shipped to the Yallourn power station, the Burmerong power station, Australia, and to Mexico and Calcutta. The first of the 80,000-kVA, 1500 r.p.m. sets for the Battersea power station of the London Power Company is now practically complete; the second set, which is being installed by the British Thomson-Houston Company, is referred to below, these being the largest 1500 r.p.m. machines so far built in this country. The original alternators supplied by the Metropolitan-Vickers Electrical Company to the Clyde Valley Power Company and the Glasgow Corporation were converted from 25 to 50-cycle machines by re-winding the stators and by supplying new four-pole rotors in place of two-pole rotors.

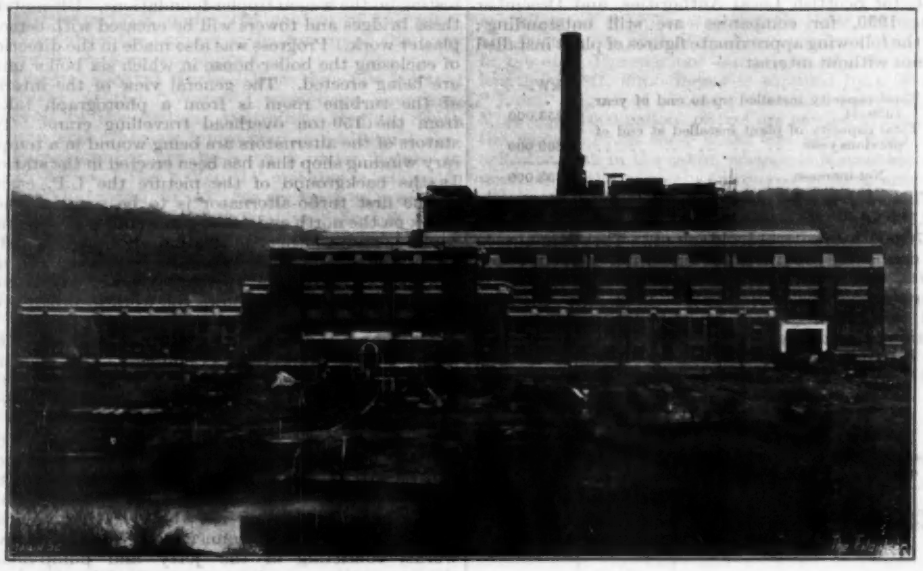


FIG. 1—IRONBRIDGE POWER STATION—FRONT OF ADMINISTRATIVE BLOCK

The B.T.H. 10,000-kW, 3600 r.p.m. turbo-alternator, designed for 365 lb. pressure, 1000 deg. Fah. and 29in. vacuum, and supplied to the Delray power station of the Detroit Edison Company, has been operating for some months under increasing temperature, and during November the final temperature of 1000 deg. Fah. was reached. There is little doubt, the makers state, that future development will be in the direction of utilising steam at a temperature of 900 deg. to 1000 deg. Fah. at a pressure of about 500 lb. to 750 lb. per square inch, although at the moment the Detroit machine is the highest temperature unit in commercial service.

The B.T.H. 67,200-kW turbo-alternator for the Battersea power station of the London Power Company is in course of erection on site. It is a three-cylinder machine, designed to operate at 570 lb. per square inch, 850 deg. Fah., and 29·1in. vacuum, as in the case of the Metropolitan-Vickers machine. A B.T.H. 50,000-kW maximum rated turbo-alternator for the Ironbridge power station of the West Midlands Joint Electricity Authority is being erected, and should be in operation within the next few months. The steam conditions are 375 lb. per square inch, 750 deg. Fah., and a vacuum of 28·9in. The two 75,000-kW, three-cylinder turbo-alternators which the firm is constructing for the new Barking extension of the County of London Electric Supply Company are claimed to be the largest machines ordered in this country. Normally, they will operate with steam at 600 lb. pressure and a total temperature of 800 deg. Fah., the maximum conditions being 700 lb. and 800 deg. Fah. The 30,000-kW, three-cylinder machine for the Ford Motor Company's works at Dagenham will shortly be completed. It will be remembered that the turbine is designed for a pressure of 1200 lb. per square inch, and for a total temperature of 725 deg. Fah. In the high-pressure cylinder the steam is expanded down to 200 lb. per square inch and reheated at this pressure to a total temperature of 550 deg. Fah. before passing to the next two cylinders, and a large quantity of the steam at 200 lb. per square inch is exhausted for process work. Two 20,000-kW B.T.H. two-cylinder machines ordered during the year for the Greenwich power station of the London County Council are to operate at 400 lb. per square inch, 750 deg. Fah., and will exhaust into a vacuum of 29in.

For the Ultimo power station of the New South Wales Government Railways, the firm supplied two 20,000-kW, 25-cycle turbo-alternators, which were manufactured partly at Rugby and partly in New South Wales. Naturally the plant as a whole had no preliminary running before the parts manufactured in the different localities were assembled on site; but, notwithstanding, the sets were put into successful operation without trouble. A new 3000 r.p.m., 45,000-kVA, 11,000-volt, B.T.H. turbo-alternator put into service at the Stourport power station of the Shropshire, Worcestershire and Staffordshire Electric Power Company, is said to be the highest rated machine running in this country at this speed. The alternator is ventilated by a separate blower driven direct from the alternator shaft.

A new 1500 r.p.m. set installed in the Hams Hall station, Birmingham, by the General Electric Company, is rated at 37,500 kVA, whilst a new G.E.C. set installed in the Nechells station of the same undertaking is rated at 30,000 kVA at 3000 r.p.m. Another large 3000 r.p.m., G.E.C. turbo-generator completed within the last few months and now in service is a 37,500-kVA machine in the power station of the Borough of Battersea.

Much interesting work was brought to our notice during a visit to the English Electric Company's Rugby works last May, when more than 200 engineers associated with supply undertakings, administrative bodies, and consulting companies were present. On the steam side there was a 30,000-kW, two-cylinder turbine for the Yorkshire Electric Power Company and a 25,000-kW, three-cylinder turbine for the Sheffield Corporation, both being 3000 r.p.m. machines for coupling to generators made at the company's Stafford works. There was a good example of the company's small surface type steam plant for industrial service, the particular unit shown being that for a textile mill in Yorkshire. In the Fullagar engine section of the works, there was a 1500 H.P.

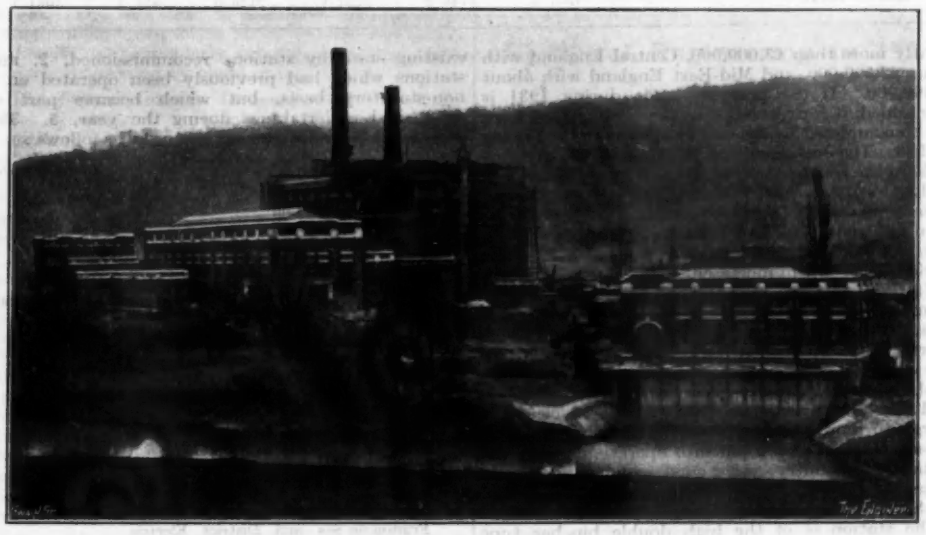


FIG. 2—IRONBRIDGE POWER STATION WITH PUMP-HOUSE IN FOREGROUND

set for Karachi and a 2500 H.P. engine for Bermuda, the largest land type Fullagar engine so far built.

Orders for large steam turbines and generators included a 15,000-kW set for Poland and a 10,000-kW set for the Hayle power station of the Cornwall Electric Power Company. Other orders received during the year were for two 2000-kW turbo-alternator sets for Cambridge, units of 3750 kW for the Reading Electric Supply Company and Hyderabad public supply, and similar units of the "all-on-one-floor" type for Whetley Mills and the Madeley Colliery Company. In most cases the installations included condenser plant and auxiliary machinery of "English Electric" manufacture. It is interesting to record that alternators of 2000-kW output are being built

by the firm for a terminal pressure of 11,000 volts, a figure usually associated with machines of larger output.

A comprehensive contract received at the beginning of the year from the Wad Medani Light and Power Company resembles in its scope a similar contract completed some years ago for Khartoum, some 150 miles away. The order embraces the power-house building, three oil engine generating units, switchgear, transformers, and a considerable amount of miscellaneous material for a water supply scheme. In addition to the orders mentioned for oil engine plant, units were put in hand for the Lymington station of Edmundsons Corporation, and for Zanzibar, and a fourth and a fifth Fullagar engine set have been completed for an overseas power station of the Admiralty.

Transformers.

The demand for large transformers created by the British "Grid" continued during the year, but it will be more profitable to refer to a few transformer developments than to consider the details of individual contracts. Besides the transformers for the National scheme, others were, of course, made for general use in this country and abroad. Export orders, for example, for Metro-Vick transformers for 110 kV and over represented something like 250,000 kVA. During the year we completed the task of describing on-load tap-changing gear by dealing with that introduced by C. A. Parsons and Co., Ltd., in conjunction with A. Reyrolle and Co., Ltd., the General Electric Company's gear, and that devised by the Oerlikon Company. Increased attention was given during the past twelve months to the Buchholz protective device, as fitted, for example, to English Electric transformers. Besides having added to its output of large "grid" units during the period under review, this company developed a standard range of distribution transformers with a view to eliminating maintenance work. The units are fitted with expansion chambers, and when necessary an inexpensive form of tap-changing switch. The Metropolitan-Vickers Electrical Company introduced a self-contained distribution transformer known as the "Transwitch," which combines a transformer with H.V. and L.V. switches and fuses in a self-contained waterproof unit.

Like other makers of large transformers, the B.T.H. Company did a considerable amount of work for the "Grid," and whilst it has always been the company's practice to design its transformers with a low-flux density in order to eliminate objectional harmonics and to ensure freedom from noise, the B.T.H. transformers for the South-West England Area have been designed for an even lower flux density than usual. One of the most interesting B.T.H. technical developments was the introduction of small power transformers for directly connecting to 132-kV "Grid" lines without intervening switchgear or fuses. From the Central Electricity Board the company received an order for two three-phase banks of transformers for this class of service, each bank being rated at 50 kVA, 132 kV/400 volts. Similar transformers may be used in the near future for giving small load supplies in isolated districts from nearby "Grid" lines. The insulation of some B.T.H. transformers for the Uhl River hydro-electric scheme has been co-ordinated with that of the system, so that the windings are definitely stronger under transient over-voltage conditions than the line. Many of these transformers have three windings, one for 130 kV and tested at 300 kV, a second for 66 kV and tested at 175 kV, and a third for 11 kV and tested at 31 kV. A B.T.H. testing transformer supplied to Bullers, Ltd., for testing insulators, is capable of giving a pressure up to 500 kV. A 132 kV B.T.H. potential transformer, as now being supplied to the Central Electricity Board, was described in our issue of July 10th of last year. Eighteen 132-kV potential transformers for the East Anglian scheme of the Central Electricity Board are being built by the Metropolitan-Vickers Electrical Company. For use with mercury arc rectifiers the B.T.H. Company is building a number of air-cooled transformers with special windings and tappings to meet customers' requirements. The General Electric Company is building fifteen 2000-kVA transformers for traction mercury arc rectifiers, and thirteen of these transformers are single-phase, air-blast units, which will be connected in sets of three, to form three-phase transformer banks.

Among other large transformers built by Ferranti Ltd. were three which are believed to be the largest so far constructed in this country. They are three-core, 50-cycle transformers, with a ratio of 11 kV/66 kV, and are operated as forced oil, water-cooled units. Their output, according to B.S.S. 171, is 80,000 kVA, with an efficiency of 99·4 at 75 deg. Cent. Had the operating conditions permitted more latitude in the specification with regard to losses, reactance, &c., the provision of an additional cooling unit would have raised the possible output of each transformer to 110,000 kVA.

An elaborate study was made by the Ferranti transformer engineers of the noise emitted by large transformers, and by means of a microphone, amplifier, and cathode ray oscillograph, many hundreds of oscillograms were taken. The noise was analysed by filtering out each component of frequency and comparing it with a standard source of noise, and in this way the result of each measurement was expressed in decibels for each component harmonic with reference to the standard source. These measurements have been made on transformers in the course of construction, under test, and on transformers in actual service.

Present-day operating conditions on distribution networks are demanding a wider use of voltage regulating devices, and Ferranti, Ltd., has given considerable attention to the development of equipment for that purpose. A new moving coil regulator, introduced by the firm, is claimed to offer certain advantages over the familiar induction regulator, despite some general similarity of characteristics. The iron circuit and primary and secondary windings are all fixed in position, and the field is controlled by a movable short-circuited coil. Hence no flexible connections or slip rings are required, and as the windings are not placed in slots the insulation problem is simplified and regulators of this type may be used on high-voltage circuits than induction regulators.

(To be continued.)

Naval Construction in 1931.

By HECTOR C. BYWATER, A.I.N.A.

No. I.

AT the close of the first decade of naval construction governed by international treaty, it is both interesting and instructive to review the effects of this political innovation so far as they have developed. The purpose of the Washington Treaty was not merely to limit the dimensions of naval armaments, but to eradicate the spirit of competition which was inflating the defence Budgets of the Great Powers and breeding mutual suspicion. To what extent, then, have these objects been achieved? So far as capital ships are concerned, the Treaty has been exceedingly effective, for it is nine years since the last vessels of this type were laid down. Until recently there seemed every prospect of the "battleship holiday" being extended to 1936, but this hope has been frustrated by the decision of France to resume the building of capital ships. Even so, the prolonged truce in heavy construction has resulted in the saving of immense sums of money, and that is a definite gain. But in other respects the system of treaty restriction has not fulfilled the hopes of its authors. It has burdened the various navies with ships of inordinate cost and problematic efficiency; it has not eliminated the competitive spirit, but only diverted it into other channels, and, above all, it has played such havoc with the balance of power that strategists and statesmen are left vainly groping for a yardstick with which to measure the relative strength of their own navy or that of any other.

Let us take these points in their sequence. Since the Washington Treaty came into force, the five signatory Powers have laid down fifty-two cruisers of the 10,000-ton 8in. gun type, which represents the maxima of tonnage and gun calibre permissible for non-capital ships. Can it truthfully be asserted that one of these ships was built to perform any specific function of strategy or tactics other than those arising out of the creation of the type itself? We think not. A compromise between the light cruiser and the heavy armoured cruiser, they exhibit the defects of each with few of the qualities of either. Their first cost is exorbitant—£2,000,000 per ship in this country—and they are very expensive to maintain, so that their multiplication is restricted quite as effectively by economic considerations as by treaty rules. The fighting value of these ships is most difficult to assess, owing to the wide discrepancy between their offensive and defensive powers. They are heavily armed, but have only the flimsiest protection, and it is generally accepted that a few well-aimed salvoes, or a single mine or torpedo, would be sufficient to disable, if not to destroy, them. They are certainly incapable of lying in line of battle, and to venture even momentarily within range of capital ships might be fatal to them. They are unduly large for the task of hunting down surface raiders, except when these are of their own type, and the same objection, added to extreme vulnerability, militates against their use as battle fleet scouts or as destroyer supports. They are, in short, hybrids for which it is difficult to find a place in the naval organisation. Never really popular with naval officers, they are now almost universally discredited, and their formal suppression as a type would be greeted with general relief. Only in the United States do they still find advocates, who believe that the maintenance of the existing cruiser standard serves as a deterrent to excessive building.

That competition in naval armaments has survived the Washington Agreement is not difficult to prove. The imposition of a limit on tonnage and armament has spurred designers to get the utmost out of every ton at their disposal. The American cruisers are remarkable for gun power; the French and Italian ships have phenomenal speeds, and the Japanese appear to combine both qualities at the expense of seaworthiness. Our own ships, of less spectacular design, are probably no better and no worse than their foreign contemporaries. The point is that there has been as much rivalry in the building of these 10,000-ton cruisers as there ever was in the construction of battleships, the only difference being that the participants in the new race have had less value for their money. In the production of lighter craft, competition is still very pronounced, France and Italy, for instance, being openly engaged in a building race for flotilla supremacy in the Mediterranean. In sum, therefore, the Washington Treaty has not proved an unmixed blessing, while the Treaty of London negotiated in 1930 is chiefly notable for the unilateral restrictions it places on British sea power.

The British Empire.

The cruiser "Exeter"—see Supplement—of 8400 tons, was the only large vessel to be completed during the year. Apart from minor modifications, she is a replica of the "York," which has been fully described in these columns. With their armament of six 8in. guns and a speed of 32¼ knots, they are very useful ships, but the design is unimaginative and presents few points of interest. The installation of an auxiliary oil-motor plant for cruising purposes would have enhanced the utility of these ships by extending their radius of action. As they carry only 1900 tons of fuel oil, as compared with the 3200 tons capacity of the "County" ships of equivalent engine power, their sea-keeping endurance is very limited for their size. With the completion of the "Exeter" our quota of 8in. gun cruisers is exhausted, and no further ship with this armament may be built before 1936. But, treaty or no treaty, it is not likely that we shall perpetuate either the "County" or the "York" class of cruiser, unless circumstances compel us to do so.

H.M.S. "Leander," the solitary cruiser provided for in 1929, was launched at Devonport on September 25th. She is the first of a new class, displacing 7000 tons and armed with eight 6in. guns in turrets. These are the only official details so far released. It is understood, however, that a speed of 33 knots is anticipated, and that all the boiler uptakes are led into a single funnel. There is vertical armour protection over a limited section of the hull. Three further units of this class, authorised under the 1930 Estimates, are now on the stocks, the "Orion" at Devonport, the "Neptune" at Portsmouth, and the "Achilles" at Cammell Lairds, Birkenhead, and two more ships provided for in the current Estimates will be started this year. In view of the rapid shrinkage in our cruiser strength, owing to age and dilapidation, it will be necessary to build on a much larger scale during the years immediately ahead if we are to keep within measurable distance of the very modest establishment to which the London Treaty entitles us. Owing chiefly to the emasculation of the five-year programme introduced in 1925, from which no less than eight ships have been dropped, and in part also to the delay in starting work on the annual programmes, the cruiser position has become far from satisfactory. In the case of the "Leander" eighteen months intervened between the voting of the ship and the laying of her keel plate, while a similar delay occurred in starting the "Orion" and the "Neptune." The last-named ships, together with "Achilles"—laid down in the early summer—form the cruiser quota for 1930, but they will not be ready for sea before the summer of 1934. Again, for the building programme of 1931 so trifling a sum was voted in the Estimates that no serious work on any of the ships can be started until the late spring or early summer of next year, which means that they will be completed by the middle of 1935. Consequently the Naval Conference, which is due to be held early in 1936, will find Great Britain with only six cruisers built and completed since the previous London Conference of 1930. This is an extraordinary position, the significance of which does not appear to be generally recognised. It means that we shall enter the next Conference almost destitute of the concrete bargaining assets which have notoriously swayed the balance at every disarmament congress in the past.

Of the three cruisers included in the current Navy Estimates, two are to be of the "Leander" class, of 7000 tons, while the third is to be a small vessel—approximately 5000 tons. A report that this vessel was designed for internal combustion machinery is officially discredited. The Admiralty evidently considers that the time is not yet ripe for effecting such a drastic revolution in the propulsion of cruising ships. To build a large motor warship at this juncture would be, no doubt, a rather bold experiment, difficult to justify when naval funds are so exiguous. In the absence of positive assurances we can but hope that the Admiralty is following the development of internal combustion machinery for naval use as closely as the importance of the subject deserves. Practical experiments are understood to be in progress at the Admiralty Laboratory with a new high-speed engine of dimensions approaching those of a light cruiser installation.

The flotilla leader "Kempenfelt," built by J. Samuel White and Co., of East Cowes, and launched in October, is a duplicate of the "Keith"—Vickers-Armstrongs—which is already in service. They are leaders only by courtesy, for their displacement of 1330 tons is the same as that of the destroyers with which they will operate, and from which they differ only in having more cabin and bridge space and a lighter armament. The "Kempenfelt" is 323ft.

overall, with a breadth of 32¼ft., the machinery consisting of turbines with single reduction gearing and an output of 34,000 H.P. The main armament comprises three 4·7in. guns. This vessel was authorised in 1929. The eight "C" class destroyers which were to have formed her flotilla were subsequently reduced to four, and all have been launched. Except that they mount four 4·7in. guns, they are identical in essentials with the flotilla leader.

Only three submarines were voted in the 1929 Estimates. They represent a break in recent building policy, which has aimed at the production of large "overseas" boats of 1475 tons, of the "O," "P," and "R" groups. One unit of the 1929 group, "Thames," is a minelayer of about 1760 tons; the other two, "Swordfish" and "Sturgeon," are "coastals" of 650 tons, the smallest submarines we have built for many years. Size, however, is not a safe criterion of efficiency in the case of submarines, for in capable hands a small boat may be quite as formidable as a larger one. Moreover, the "Swordfish" is very strongly armed for her tonnage, six torpedo tubes being mounted in the bows alone. Three boats of this class can be built for the price of two "overseas" craft, and would probably represent better value. Three submarines authorised under the 1930 Estimates are on the stocks—the minelayer "Porpoise," of the "Thames" class, at Vickers-Armstrong, Barrow; and the coastal boats "Starfish" and "Seahorse," at Chatham Dockyard.

The "ca' canny" policy which has been pursued in recent years with reference to cruisers is equally marked in the case of submarines. Only thirteen boats have been authorised in the past four years, and three of them have yet to be laid down, while in the same period a larger number of older submarines have passed the limit of useful service. Since the war ended only twenty-five submarines have been provided for the British Navy, in contrast to the huge volume of submarine tonnage launched abroad. At the present moment, for example, forty-two submarines are under construction in France alone, and nearly thirty in Italy.

The "Bridgewater" class of small sloops, introduced in 1927, has now grown to fourteen units. They displace from 1040 to 1105 tons, have turbine machinery of 2000 S.H.P. for a speed of 16 to 16½ knots, and carry two 4in. guns on high-angle mountings. These little ships have notoriously been built to eke out our shrinking cruiser tonnage, but actually their fighting value is negligible. The only function they could perform in war would be minesweeping. In size, armament and radius they are completely eclipsed by the French motorised sloops. It is a singular fact that one type of ship for which there would be an urgent demand in a national emergency has been studiously ignored in our post-war programmes. This is the convoy cruiser, the development of which has been strongly urged by naval officers who were most intimately associated with the convoy system in 1917–18. The desiderata of this type are moderate speed, ample sea radius, and strong armament, all of which might be incorporated in a ship of less than 2000 tons. As ships below that tonnage are not limited by Treaty, there is nothing to prevent us from building convoy cruisers, which would be of incalculable value, in place of the present sloops, which are a dubious investment from any point of view.

United States.

The last of the eight 10,000-ton cruisers authorised under the Act of December, 1924, was completed during the year. They are not uniform in design, for the "Pensacola" and "Salt Lake City," which went afloat first, were discovered to be over-gunned and deficient in stability, and in the next ships the armament was cut down to reduce the weight on deck. Thus the "Augusta" and her five sisters differ from the "Pensacola" in mounting nine 8in. guns instead of ten; the length has been increased from 585½ft. to 600ft., and the breadth from 64ft. to 65ft., and the freeboard has been raised. Although nominally of 10,000 tons, these American cruisers are officially claimed to displace only 9050 to 9100 tons, thanks to weight-saving methods of construction and the meticulous avoidance of cumbersome equipment. Apparently these methods have been carried too far, since a number of the ships have recently gone into dockyard with cracked stern-posts, while heavy weather and gun concussion have revealed other weaknesses. It is not denied that all eight ships are exceptionally lively in a seaway, a fact which appears to discount the practical value of their heavy armament. The propelling machinery is the same in all ships, consisting of Parsons geared turbines taking steam from eight White-Forster boilers—excepting in "Northampton," which has eight of the Yarrow type—and developing 107,000 S.H.P. The mean trial speed was 33 knots. While this type may not be an unqualified success, it is at least ingenious and progressive, especially in the lay-out of deck space and equipment. This latter includes four seaplanes, with enclosed hangars for two machines, and two catapults, all neatly stowed away without marring the profile of the ship. Finally, if it be true that the radius is 13,000 miles at 15 knots, as compared with the 10,400 miles at 14 knots of the British "Counties," the American designers must be congratulated on a brilliant technical achievement. Seven further ships of the same generic type are under construction, bringing the total of "10,000-ton" 8in. gun ships to fifteen, and giving the United States "parity" in this class of vessel.

It was intended to lay down this year a flotilla leader and ten destroyers, but in deference to economy only five boats have been ordered. The displacement is to be 1500 tons and the cost nearly £1,000,000 per vessel, but no other details are to hand. With the completion of the submarines "Narwhal" and "Nautilus," of 2760 tons, it was decided to make a drastic cut in dimensions, and the "Dolphin," "Cachalot," and "Cuttlefish," now on the stocks, displace only 1560 tons. The armament is to be one 4in. gun and six torpedo tubes, in place of the two 6in. guns and the six tubes carried in the larger boats. On the other hand, the surface speed is to be increased from 17 knots to 18.

The aircraft carrier "Ranger," of 13,800 tons, laid down at Newport News in 1930, is due to be launched this year. Her speed is reported to be 33 knots, her armament eight 5in. guns, and her capacity seventy-six aeroplanes. A sister ship may be laid down in the present year.

Japan.

The "Chokai," launched on April 5th, was the last of the Japanese 10,000-ton cruisers to go afloat, and is the eighth of her type. All exhibit the same remarkable profile, with an undulating deck line, sharply raking, trunked-in funnels, massive bridge-work, heavy director towers, and the pyramidal disposition of turrets in the forepart of the ship. Like their first American contemporaries, they mount ten 8in. guns, but in the Japanese ships the twin-mounting system is retained, and both vertical and deck armour protection is stated to be very substantial. Finally, the machinery generates 130,000 S.H.P. for a speed of 33 knots. How the designers have contrived to compress all these qualities into 10,000 tons is a secret known only to themselves. If the details are reliable, these cruisers are, indeed, the "wonder ships" of the day, but it is possible that some of their features are exaggerated. Besides the eight 10,000-ton ships, Japan has completed four cruisers of 7100 tons, armed with six 8in. guns apiece. Her quota of 8in. gun ships is therefore filled, and in common with this country she is debarred by the London Treaty from building any further ships with this armament until 1936. It is not the least anomalous feature of the London covenant that it should preclude the British Empire and Japan from building a type of ship which continues to be actively developed by the United States, France and Italy. As our last big 8in.-gun cruiser was begun in September, 1927, it follows that she will be outclassed by foreign ships which have either just been started or will not be laid down for another year or so. It is a pity that this obvious fact was overlooked by the British delegates who helped to draft the London Treaty.

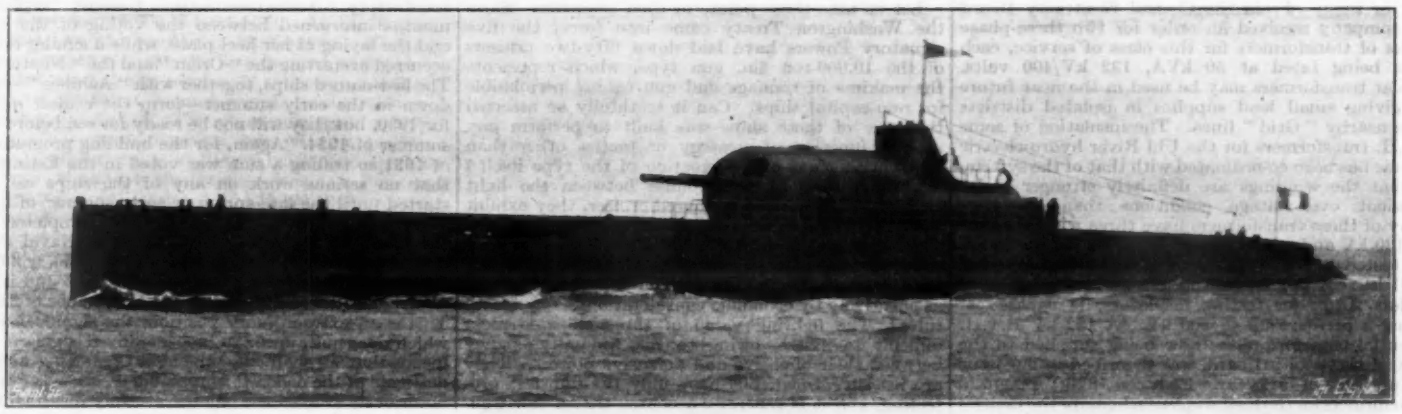
After the "Chokai," the largest Japanese ship of war to be launched during the past year was the aircraft-carrier "Ryujo," of 7600 tons. Her principal characteristics are:—Length, 548ft.; breadth, 60ft. 6in.; turbine machinery of 40,000 S.H.P., for 25 knots; armament, twelve 5·1in. anti-aircraft guns. This vessel, which was laid down at Yokohama in January, 1930, appears to be a reduced version of the "Hosho," and, like her, will be fitted with gyro-stabilisers. She is the fourth aircraft-carrier to be built for the Japanese Navy. A number of destroyers were launched during the year. They belong to the "Fubuki" class, twenty-four in all, the nameship of which was launched in 1927, and they are the most powerful destroyers, as distinct from leaders, which have yet been built. The dimensions are:—Length, 367ft.; breadth, 34ft.; draught, 10¾ft.; displacement, 1700 tons; machinery, Parsons geared turbines and Kampon boilers, developing 50,000 S.H.P., the designed speed being 35 knots. The armament comprises six 5·1in. guns, two A.A. guns, and nine 21in. torpedo tubes on triple mountings. The 5·1in. guns are mounted in pairs, each mounting enclosed in an armoured gas-proof shield. This is a decided novelty in destroyer armament. The torpedo broadside is exceptionally heavy; in fact, the whole armament is the heaviest ever mounted in destroyers. The Japanese principle of endowing every naval unit with the maximum fighting power compatible with its tonnage finds emphatic expression in these remarkable craft. Submarine construction appears to have been slowed down, only five new boats being reported on the stocks at the time of writing. They are vessels of 1638 tons and a surface speed of 19 knots. There are now seventy-two Japanese submarines completed or building, twenty-three of which are capable of 19 knots.

France.

A battle-cruiser of 26,000 tons is among the ships projected for commencement this year. Originally planned to displace 23,330 tons and to carry 12in. guns, the vessel has been re-designed to mount eight 13·4in. guns. The construction of such a unit has long been urged in French naval circles to counteract the German "pocket battleship" "Deutschland," of 10,000 tons and six 11in. guns, but it must be admitted that the French "reply" is rather overwhelming. The ship, provisionally named "Dunquerque," will probably be laid down at Brest.

In December the 10,000-ton cruiser "Algérie" was launched at Brest, almost exactly twelve months after the laying of her keel. The seventh vessel of this type to go afloat for the French Navy, she differs from her predecessors in having lower speed—31 knots, as against 33–34—and more substantial protection, a 6in. belt on the water line taking the place of the flimsy plating of earlier ships. Moreover, the turrets and hoists are to be strongly armoured instead of being merely splinter-proof, as in previous designs. The main armament of eight 8in. guns is unchanged, but the A.A. battery is to consist of twelve 4in. guns. The "Algérie," like the Italian "Zara," appears to be a genuine armoured cruiser, and should therefore be a better fighting unit than the majority of 10,000-ton cruisers, to which the term "tin-clad" has been not inaptly applied. The "Foch," a 10,000-tonner launched in 1929, was completed during the year under review—see Supplement. It is doubtful whether France will build any further ships of this tonnage, for the six cruisers authorised in the programmes of 1930 and 1931 are of 7500 tons. The first two, "La Galissonnière" and "Jean de Vienne," have yet to be laid down, the design having undergone modification since its inception. Six-inch guns will be mounted, either eight in twin or nine in triple turrets, and a speed of at least 35 knots is foreshadowed.

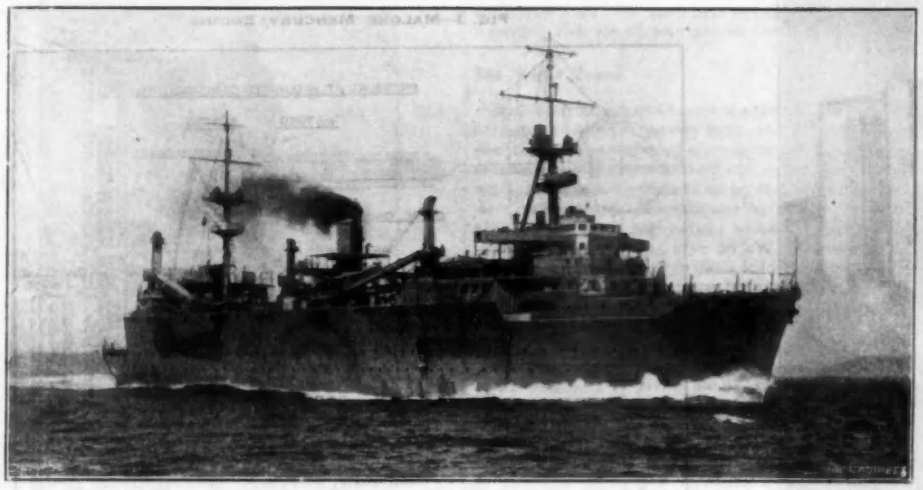
A new minelaying cruiser, "Emile Bertin," is to be launched this year at St. Nazaire. She is an improved version of the "Pluton," completed last



FRENCH SUBMARINE CRUISER "SURCOUF"

April, which is a ship of 4850 tons and 30 knots speed, carrying four 5·5in. guns and 250 mines. The "Bertin" will exceed 6000 tons, her speed will be 30 knots, and she is to mount nine 6in. guns in triple turrets. This will be the first appearance in the French Navy of the 6in. triple mounting, which has been adopted in all the German post-war cruisers, though its superiority over the twin mounting as regards volume of fire is yet to be demonstrated. Another "special type" cruiser completed during the year is the "Jeanne d'Arc," designed primarily as a training ship for naval cadets. She is 525ft. long by 57½ft. beam, has turbine engines for 25½ knots, and a main armament of eight 6·1in. guns. From 1922 to 1931 inclusive France has built and authorised nineteen cruising ships, as against twenty-three provided for the British Empire.

Four large flotilla leaders were launched in the past year, and twelve others are now on the stocks. They are ships of 2441 to 2500 tons, with a designed speed of 36 knots, and an armament of five 5·5in. guns and six to eight 21·7in. torpedo tubes. Thirty of these leaders have now been built or laid down, and a further unit—2600 tons and 42 knots—is to be started this year. The type is peculiar to the French Navy, and although very impressive on paper its functions appear to be obscure. Vessels of this size and cost are quite unsuitable for ordinary torpedo work, and at the same time are unnecessarily large for dealing with hostile destroyers. Theoretically they are powerful enough to engage light cruisers, but in practice the latter possess a marked advantage by reason of their superior steadiness as gun platforms. The French leaders, it is true, have given some astonishing steaming performances, speeds up to 42·78 knots having been attained on trial, but the tactical value of speed is still a subject of controversy. The inclusion in this year's programme of a solitary destroyer, experimental in design, may presage a reversion to smaller dimensions in French torpedo craft construction.



FRENCH AIRCRAFT TENDER "COMMANDANT TESTE"

Among the forty-two submarines in hand at the close of the year are units of the "Redoutable" class, which with slight modifications has been steadily developed since 1924. The latest boats are of 1384 tons on the surface and 2080 tons submerged. All are equipped with two sets of Sulzer-Diesel engines with a combined output of 6000 H.P., giving a surface speed of 18 knots, usually exceeded by 1 knot on trial. Electromotors of 2000 H.P. produce a speed of 10 knots below the surface. The hull is 302ft. by 30½ft., and is very strongly built. These vessels can cruise at sea for thirty days. They are armed with a 3·9in. gun and eleven 21·7in. torpedo tubes, including two pairs of revolving carriages. Every boat is required on completion to make an independent voyage of several weeks' duration. The type has given evidence of seaworthiness and engine-room reliability under all conditions, and is unquestionably one of the best submarine designs extant. The minelaying submarine "Rubis," the sixth of her class, was launched on September 30th. The surface displacement is 670 tons, and the speed 12 knots. Armament: one 3in. gun, four torpedo tubes, and thirty-two mines carried in separate chutes. A large number of second-class submarines are under construction, thirty-one boats of these types having been laid down since 1924. The latest displace 571 tons, have a speed of 14 knots, and are armed with a 3in. A.A. gun and eight tubes. The endurance at economical speed is 3000 miles. Eight convoy sloops have been authorised for building, but the design does not appear to have been settled. The first quartette of of "Colonial" sloops, "Bougainville" class, was launched during the year. They are Diesel-driven ships of 1968 tons and 15½ knots speed, with a radius of 9000 miles at 10 knots. Each mounts three 5·5in. guns and four light A.A. pieces, is fitted for laying mines, of which fifty are carried, and is able to carry a seaplane. They are useful and economical ships which compare more than favourably with the British sloops of the "Bridgewater" series. The aircraft tender "Commandant Teste," of 10,000 tons and 20½ knots speed, was commissioned during the year. She carries seaplanes, and has four catapults, but there is no flying-on deck, and the utility of this ship does not appear to be very great.

During the year trials were continued with the French submarine cruiser "Surcouf," a view of which is reproduced on page 8. This vessel, which was laid down at Cherbourg in 1927, has a surface speed of 18 knots and 10 knots submerged, and is the largest submarine in the world. She is armed with two 8in. guns fixed on a turret which apparently cannot be trained, so that in order to bring the guns on to their target it would appear to be necessary to manœuvre the whole ship. The "Surcouf" has a radius of action of 10,000 miles at 10 knots.

Italy.

The largest ship launched during the year was the 10,000-ton cruiser "Pola," the sixth of her class. She has better protection than the earlier ships and the speed has been reduced to 32 knots, but the armament of eight 8in. and sixteen 3·9in. guns remains unaltered. A seventh vessel, "Bolzano," is to go afloat this year. In her case the speed has again been raised to 35½ knots at the expense of protection. Widespread interest has been evoked by the trials of the "Condottieri" cruisers, of 5250 to 5550 tons. Four of these eight ships have been completed, and in each case the designed speed of 37 knots was considerably bettered during trials. The "Alberico di Barbiano" reached 42·048 knots, the "Alberto di Giussano" made 40·7 knots, and the other two came within a fraction of 40 knots. Still more remarkable was the eight hours' endurance test of the "Barbiano" at a mean speed of 39·74 knots. This trial was made with the ship displacing 5607 tons, the full armament being on board. Besides bringing a powerful reinforcement to the Italian Navy, these cruisers reflect exceptional credit on those who have designed, built, and engined them. Another steaming record is claimed on behalf of the large destroyer "Alvise Cadamosto," of 1654 tons and a designed speed of 38 knots. The machinery has a nominal output of 53,500 tons, but during a recent trial run 71,000 H.P. was obtained and the speed of the ship over the measured mile was 44 knots. Another unit of this class, "Emanuele Pessagno," is illustrated in our Supplement. Twelve smaller destroyers, from 1225 to 1472 tons and 38 knots, are in various stages of construction. In these craft all the uptakes are led into a single funnel and super-structure has been cut down to the minimum. The twenty-two submarines authorised in 1930 were all begun during the past year. Among them are four of the "Balilla" class, which has proved very successful. The surface displacement is 1390 tons, the speed 18½ knots, and the armament comprises a 3·9in. gun, six torpedo tubes, and sixteen mines with laying gear. They are specially built for deep diving, and the "Balilla" herself reached a depth of 55 fathoms during her trials. The new coastal type, of which nineteen are building, is of 636 tons with a speed of 14 knots and the same armament as the "Balilla," except that no mines are carried.

New construction for the secondary navies will be reviewed in a subsequent article, but mention may be made here of the remarkable pair of Argentine cruisers, "Almirante Brown" and "Veinticinco de Mayo"—see Supplement—which were built by the Italian firms of Odero and Orlando respectively. Displacing only 6800 tons, they have a speed of 32 knots and mount the formidable armament of six 7·5in. guns in twin turrets, twelve 3·9in. A.A. guns, and six torpedo tubes. The single large funnel, splayed tripod foremast, and clipper bow give these ships a very distinctive appearance.

(To be continued.)

Progress in Prime Movers in 1931.

ENGINEERS as a whole are conservative. Preference is given as a rule to gradual advances rather than to radical departures from successful designs made in the hope of gaining by this swift advance comparative advantages. The record of 1931 is, therefore, one of steady, though slow, advance, as far as prime movers are concerned. This generating station, for instance, utilises a higher steam pressure, and that a higher temperature; the oil engine has been designed to run at higher speeds and investigations of combustion chamber designs are being made; hydro-electric plants have been designed to use greater heads. Such developments are normal to the run of progress, and such installations can be erected with a fair degree of reliability and confidence from the experience gained with plants of a less exacting nature.

Nevertheless, there are always pioneers blazing the trail towards developments that the general run of mankind has examined, but considered to be, in the present state of knowledge, of doubtful practical value. Such work, besides being of very great interest, is also of some importance. Although the machines designed may not meet with success, the experiments are certain to point out unsuspected pitfalls that will sooner or later have to be circumvented, or bring to light unexpected facts to be of use at a later date. Many such experimental installations were tested during 1931. Some approached success, others, although by no means failures, served to demonstrate that many problems yet remain to be solved; while others, again, appear to hold out but little hope of any success.

The Benson Boiler.

In the field of steam engineering there has been, ever since the end of the war, a tendency to utilise higher pressures and higher temperatures, America, perhaps, preferring rather to develop the first, while

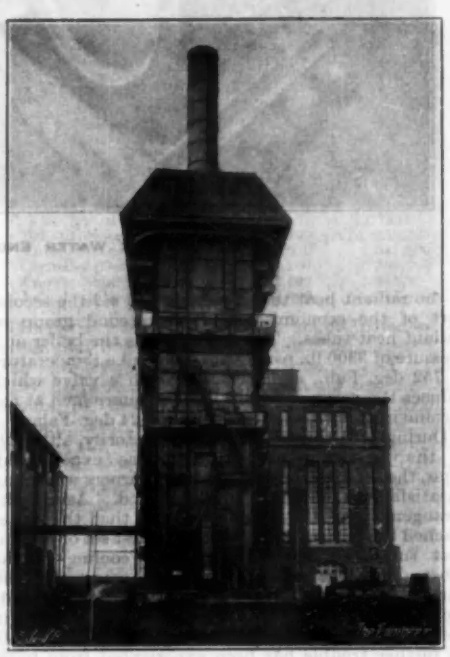


FIG. 1—BENSON BOILER AT LANGERBRUGGE

Europe is concerned rather with the second. Few engineers, however, care to make the leap to the critical pressure developed in the Benson boiler. Yet such boilers are in use, both on land and at sea. The advantages attendant upon the use of so great a steam pressure are not only that of increased thermal efficiency, but also those of saving both in space and weight, a consideration particularly desirable on shipboard. On the s.s. "Uckermark," built by Blohm and Voss for the Hamburg-Amerika Line, a Benson boiler installed for trial displaced one double-ended boiler generating steam at 220 lb. per square inch out of a group of two double-ended and two single-ended boilers, and was capable of generating all the steam required by the main turbine. In order to break down the steam pressure to that suitable for the main turbine, two high-pressure turbines in series are used in front of the existing machinery. The Benson boiler is a development from the old flash type boiler known many years ago. Steam is generated at the critical state, 3200 lb. per square inch pressure and 705 deg. Fah. temperature, at which the latent heat of vaporisation is zero and the specific volume of dry saturated steam equals that of the liquid. The water passes off into steam without ebullition, there being at this critical point no distinction between steam and water, while the steam produced is already dry. It is further heated before use, and it is usually necessary to re-heat it in the course of its expansion through the turbines. On

board the "Uckermark" the water is delivered by two electrically driven feed-water pumps. The boiler itself consists of a number of tubes divided into four portions, two of which are open to the radiant heat from the furnace, the others being analogous to economisers. The water flows first through one of the economiser groups of tubes, thence to the first part of the radiant heat tubes, passing out *viâ* the second part of the economiser and the second group of radiant heat tubes. The steam leaves the boiler at a pressure of 3300 lb. per square inch and a temperature of 752 deg. Fah., and passes through a valve which reduces the pressure to 882 lb. per square inch at the turbine inlet with a temperature of 824 deg. Fah.

During 1931 this boiler ran satisfactorily, although in the preceding year trouble was experienced. First, the arrangement of the ten oil burners was found unsatisfactory and had to be altered. Again, the arrangement of the pipes was such that the water reached the critical point within the first set of radiant heat tubes, resulting in improper cooling of the tubes, with the consequence that some of them burst. As a result of alterations carried out towards the end of 1930, the critical point is now reached in the second part of the economiser portion, and to date no further trouble has been experienced from burst pipes.

At Langerbrugge power station a land type installation of a similar boiler has been erected by Siemens-Schuckert Werke G.m.b.H. It is illustrated in Fig. 1. The boiler appears to be of an experimental nature. It is rated to deliver 100 to 135 tons of steam per hour, at a pressure or 224·2 kilos. per square centimetre. This steam is first expanded from 200 to 60 kilos. per square centimetre in a 4000-kW turbine, and subsequently, after re-heating in the same boiler is expanded to a vacuum in a 25,000-kW turbine. The boiler consists of twenty-eight steel coil tubes of small diameter, 6·35 mm. thick, the radiant heating surface being 502 square metres, and the economiser surface 872·5 square metres. The boiler is equipped to use powdered coal, but some of the burners are arranged for use with blast-furnace gas and some for oil. Many experiments are being carried out on the boiler. Early in the year the direction of circulation in the tubes was reversed, and the boiler was recently again dismantled for further improvements. Its longest continuous run during the year was, we understand, twenty-one days.

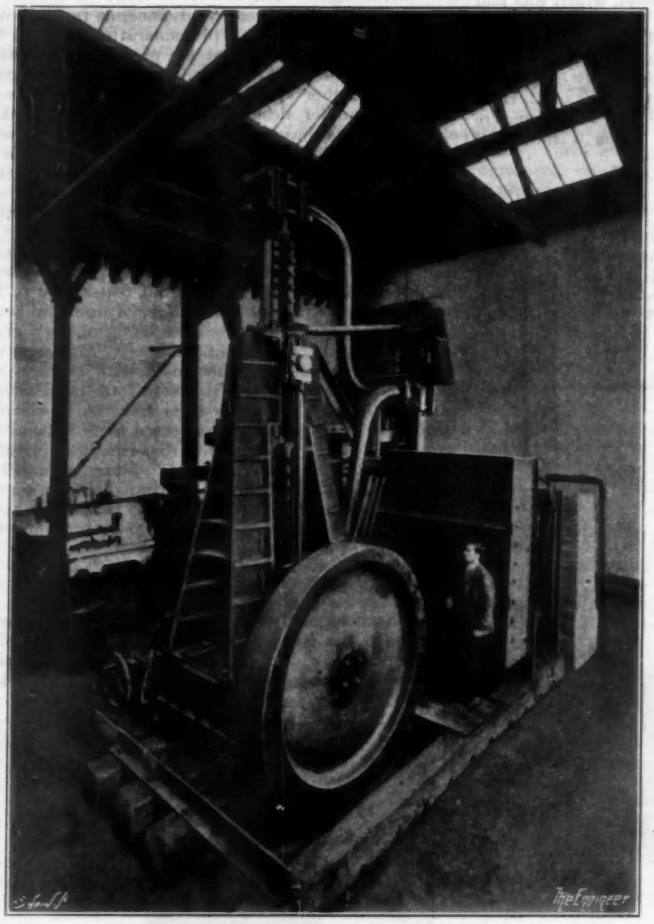


FIG. 2—MALONE WATER ENGINE

Binary Fluid Systems.

By the use of two fluids it is possible to obtain high thermal efficiencies without the use of the very high pressures necessary when steam is employed. In America a 20,000-kW binary fluid plant of the Emmett type, utilising mercury as the high-temperature medium, is being constructed at Schenectady, by the General Electric Company. In Germany, however, work upon the projected plant to be erected in one of the large Berlin power stations and designed in accordance with Dr. Koenemann's binary fluid system, in which ammoniated zinc chloride is used, has been held up, owing to the difficult industrial position and a falling off in the demand for power. A small plant is, however, at work in an experimental station in Berlin, and during 1931 investigations were concentrated upon the economic production of the zinc salt and the discovery of suitable materials for those parts of the plant subjected continuously to high temperatures.

The Malone Engine.

An entirely new prime mover was described during the year in this country. On June 4th a paper was read by J. F. J. Malone before the Royal Society of Arts describing a thermo-dynamic engine utilising water as the working medium. The cycle upon which it works is similar to that of a hot air engine, but by the use of water as the medium, the size and weight of the machine are kept down to a degree comparable with those of the steam engine. Fig. 4 illustrates diagrammatically the principle upon which the engine works. Attached to the crank shaft is an excentric leading the crank by 90 deg., and driving a heat exchanger, the water within which is continuously connected with that in the cylinder. To obtain power from the engine it is necessary that when the ram in the cylinder is at inner dead centre, the temperature of the water in the system shall be rising. Expansion of the water will then drive the ram outwards. At the beginning of the inward stroke the temperature of the water must be falling, so that the ram can return against a smaller resistance. These charges in temperature are brought about by the action of the heat exchanger, or, as Mr. Malone calls it, the thermo-dynamic or T.D. pile. The movements of the excentric drive the water backwards and forwards from one end of the T.D. pile to the other. Since one end of the pile is heated by a furnace, while the other end is cooled by a flow of water, this action causes the temperature to be alternately raised and lowered, and, owing to the fact that the movements of the water in the T.D. pile are caused by the excentric to be 90 deg. in advance of the movements of the ram in the cylinder, it follows that :—

(*a*) As the ram approaches the inner dead centre the water in the T.D. pile is driven towards the hot end. The consequent expansion drives the ram down the cylinder.

(*b*) At half-stroke of the main crank as much water as possible has been pumped to the hot end of the pile.

(*c*) As the ram approaches outer dead centre the water in the pile is being transferred to the cold end with consequent contraction.

(*d*) While the ram is moving inwards most of the water is at the cold end of the pile and is consequently falling in temperature.

It will be observed that owing to the relative placing of the crank and the excentric the water in the pile is not being transferred when the ram is moving most rapidly, while when the ram is stationary at the dead centres rapid transference of the water from one end of the pile to the other is taking place.

The water pressures within the cylinder at various parts of the stroke are approximately 5·3 tons per square inch at inner dead centre ; 4·3 tons per square inch at half the outward stroke ; 1·4 tons per square inch at outer dead centre ; and 2·3 tons per square inch at half the inward stroke. At full power the mean effective pressure is no less than 3000 lb. per square inch. In effect 100 H.P. could be developed at 200 r.p.m.—nearly the maximum speed attainable—in a cylinder 3in. in diameter with a stroke of about 10in. Since the water in the cylinder can never come directly from the hot end of the pile without passing

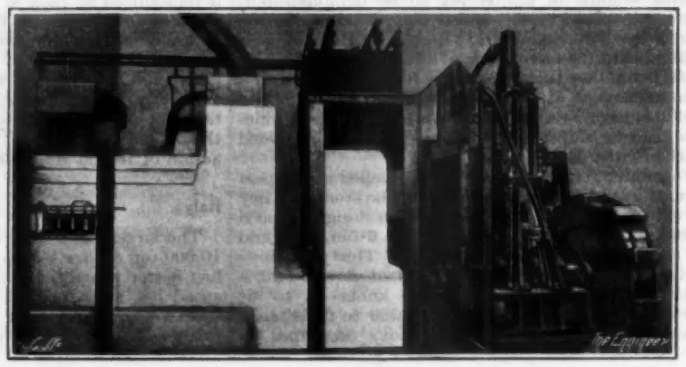


FIG. 3—MALONE MERCURY ENGINE

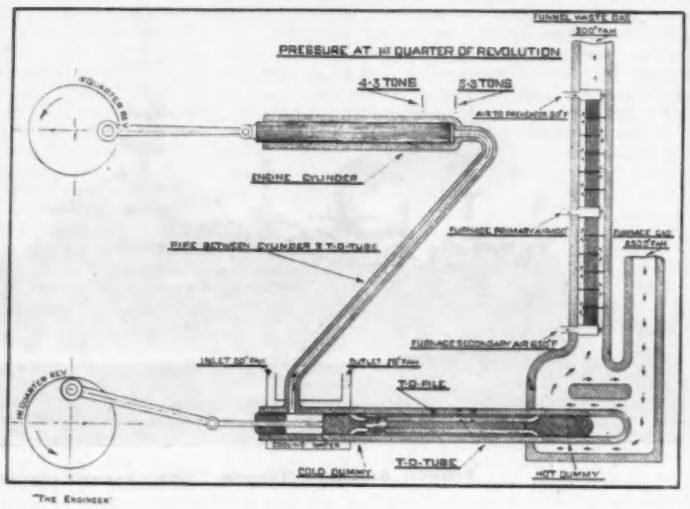


FIG. 4—MALONE ENGINE—DIAGRAM OF CYCLE

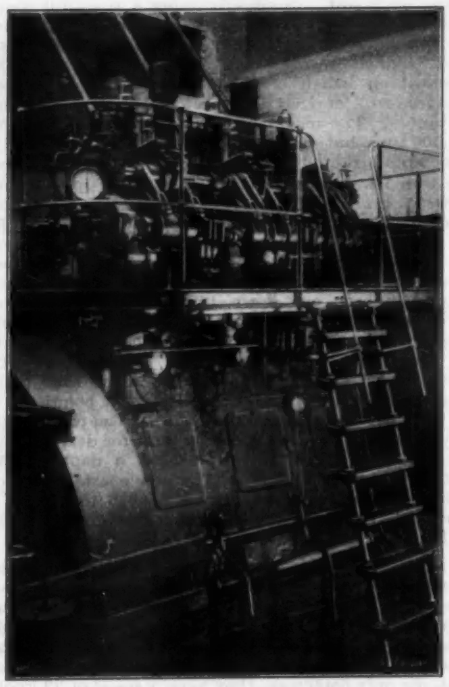


FIG. 5—COAL-DUST ENGINE

through the cold end, it is always cool and consequently the gland works under good conditions. Figs. 2 and 3 illustrate the appearance of two engines working on this system. The small dimensions of the cylinder can be seen, as can also the furnace responsible for heating the T.D. pile. Various liquids have been employed. In the engine illustrated in Fig. 3 mercury was used as the working medium, but, on the whole, on the score of its cheapness and good thermodynamic properties, water has been found the most suitable. Mr. Malone's paper was reprinted in THE ENGINEER of July 24th, 1931.

Coal-Dust Engines.

As far as oil engines are concerned, most investigation during the year 1931 was concentrated upon the development of the high-speed type. Rudolf Pawlikowski, in Germany, has been devoting himself, as in past years, to the improvement of a Diesel engine capable of running on coal dust or other solid fuels.

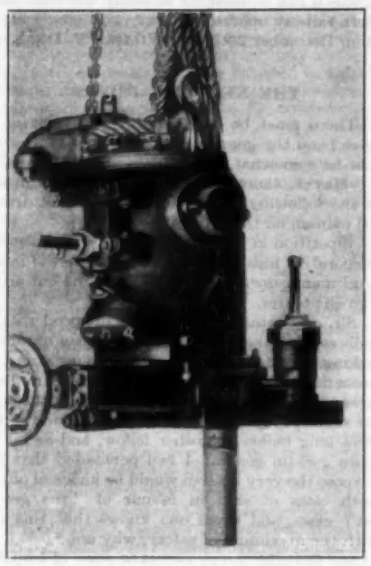


FIG. 6—COAL-DUST INJECTOR UNIT

The engine, as can be seen from the engraving Fig. 5, is perfectly normal and is in fact an ordinary oil engine adapted for use with coal. The difference lies in the arrangement for injecting the fuel. This apparatus is illustrated in Fig. 6. The greater part of the pot to be seen in the engraving provides storage for the coal which flows from the hopper-like affair to a chamber, where it is given a whirling motion and injected thence into the cylinder by an air blast. The combustion space is provided with an antechamber, and once the engine is warm it is possible to shut off the blast and draw the coal dust into this chamber on the suction stroke. The ash contained in the coal constitutes the greatest difficulty, since if it is not removed great wear of the cylinder liner takes place. The difficulty has been partially overcome by using a plentiful supply of lubricating oil, cleansing it continuously in a separator. During the year numerous experiments were carried out on an 80 H.P. engine, and it was demonstrated that it could run on a

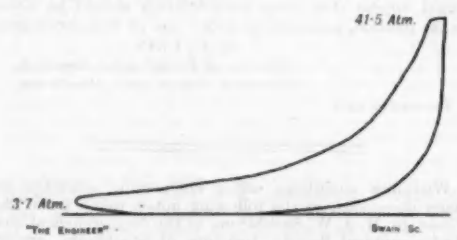


FIG. 7—COAL-DUST ENGINE DIAGRAM

wide variety of fuels ranging from good coal to waste products of small heat value. The claim is made for the engine that it can run more economically than either the oil engine or the steam turbine. Its advocates state that using lignite as a fuel it requires 8000 B.Th.U. per H.P. hour, as compared with 7000 B.Th.U. per H.P. hour for the oil engine using fuel oil. Taking the comparative costs of oil and lignite into account this shows a considerable saving. For comparison with modern turbine plants a thermal efficiency figure of 35 per cent. is claimed for the coal-dust engine of 80 H.P., which means a substantial saving for small horse-powers and a not inconsiderable one for large. It is further pointed out that by the use of brown coal large mean effective pressures can be obtained with low maximum pressures owing to the fact that such coal contains a large quantity of oxygen in a state suitable for combustion, the effect being equivalent in some ways to supercharging. The indicator card shown in Fig. 7 was taken soon after starting up on lignite with the engine cold. It is unusually "fat," the mean effective pressure being high, although the maximum pressure is only 41·5 atmospheres. As a result of the work done during the year the engine appears to have passed out of the experimental stage and to be now ready for commercial development, although no doubt much remains yet to be done.

Hydraulic Engineering.

Although hydraulic engineering made considerable progress during 1931, development, hampered somewhat by the prevailing depression, was along normal lines. The head that can be utilised in a power plant has now reached so high a figure that it seems unlikely that it can rise much higher. By this we do not mean that it is beyond the powers of engineers to build Pelton wheels capable of utilising greater heads, or pipe lines capable of withstanding the pressure, but that the situations in which hydraulic power stations can be placed to utilise very great heads are severely limited. Water turbines continued to develop during the year for use with both greater and smaller heads than heretofore, while attention was also directed towards tidal power schemes, but at present the difficulties in the way of producing power economically from such a source seem to be insuperable. The great problem, that of storing sufficient power or sufficient water for use when no power can be obtained from the tide itself, remains to be solved.

Sea Water Power.

Monsieur Georges Claude continued during 1931 his attempt to obtain power from the difference in temperature of the water at the surface and at the bottom of the sea. He conducted his experiments in Cuba with the Claude turbine built by the Société Alsacienne de Constructions Mécaniques at Belfort and originally used for experimental trials in France. This turbine is designed to give 50 kW at 6000 r.p.m. with an initial pressure of 0·0323 kilos. per square centimetre absolute and temperature 25 deg. Cent. and an exhaust pressure of 0·0125 kilos. per square centimetre absolute and a temperature of 11·5 deg. Cent. The turbine has a single wheel 800 mm. in diameter. The steam consumption, with an adiabatic heat drop of 23 calories, is given as 63·4 kilos. per kW-hour. Although there does not appear to be much chance of developing power economically in this manner, a large pipe was lowered into the sea at Cuba and the plant has been run experimentally. At the beginning of October Monsieur Georges Claude described in Paris what had been done and claimed that the practical value of this method of obtaining power from the sea had been demonstrated, although certain technical difficulties remained to be overcome. He described a plant which would leave 40,000 kW for distribution. The extraction of air would consume 3000 kW, the raising of the water 8000 kW, and the pumping of the water back to the sea 2600 kW. The piping system used at Cuba was, however, unsatisfactory and would have to be abandoned, he stated, as unsatisfactory and be replaced by a new design.

Although the majority of the installations described in this article are foreign, it must not be supposed that this country is not also investigating new developments. Here, however, the tendency has been towards steady improvement rather than towards rapid advances. It may well be that in the long run this unspectacular but nevertheless steady progress will prove to be of the greater advantage. Other annual articles in this issue demonstrate fully that this country is doing more than hold its own, and that when the depression that has lain so heavily upon industry during the last twelve months, and shows as yet but little sign of breaking, does at last lift, she will be able to offer prime movers as good and better than those of her competitors.

International Steel Conditions in 1931.

By E. T. GOOD.

THE 1931 output of steel in all countries put together will prove, when we get the complete returns, to have been about 40 per cent. less than the 1929 output. In the closing weeks of 1931 production was at a rate barely 50 per cent. of that of 1929 production. France is operating nearer to the top level than any other country. Belgium and Luxemburg are doing well compared with other countries. Taken all round, however, the slump is very pronounced, for reasons not far to seek or in any way puzzling. It is not that the world's appetite for steel has diminished. It has increased. But the prices of farm and forest and mine products have dropped heavily; producers of food, timber, and minerals have very little money to spend; the demand for all sorts of steel and steel products—from ingots and huge plates to fencing wire and buckles for horse harness—has fallen; railway extensions planned have had to be held up; shipping freights have fallen below pre-war levels, though expenses are much higher, and therefore shipbuilding has greatly declined. But just as the depression has been long drawn out and exceptionally deep, so will the revival, when it comes, be the more speedy and lasting. Wood, stone, and bricks will be increasingly substituted by steel, for of the four commodities, or groups of materials, steel alone improves in quality, extends in utility, and cheapens in cost.

As compared with pre-war prices, all constructional materials are much dearer, except steel. It does not seem that science and inventions can improve or cheapen wood, stone, or brick. Science and inventions are constantly improving and cheapening steel. Again, so far as wood is concerned, the world's resources are being depleted far more rapidly than Nature is producing them, and few, if any, countries, except Germany, are planting new trees to the same number as old ones are being cut down. There is enough iron ore in the world to serve a huge steel industry for centuries to come, without any suggestion of exhaustion. There is coal enough to smelt the ore for generations to come. And metallurgists and engineers are constantly making steel and steel products more acceptable to buyers and users. The future of steel is assured—absolutely. As soon as financial and political matters become normal, steel will be in greatly increased demand for railways, bridges, house building, road-making, shipbuilding, mine props, and beams, house and office furniture, farming and forest implements and tools.

Meanwhile, we have the slump proved by these figures:—

Production of Steel, Monthly Averages, in Tons.

	Britain	U.S.A.	Germany.	France.	Belgium
1929	803,000	4,513,700	1,332,700	792,800	339,000
1930	608,200	3,304,400	946,500	771,300	285,000
1931 — last recorded month:					
September		1,547,600		645,700	274,100
October ..			593,700		
November ..	459,200				

November was the best month since March for output in Britain. Here are the figures:—

Steel Production in Britain, in Tons.

1931—March	500,100
April	397,400
May	435,100
June	428,900
July	428,700
August	357,300
September	400,500
October	457,400
November	459,200

The decline in twelve months is shown herewith:—

Steel Production in Single Months, in Tons.

	1930.	1931.
Britain (November)	433,800 ..	459,200
United States (September)	2,868,000 ..	1,547,600
Germany (October)	844,200 ..	593,700
France (September)	752,100 ..	645,700
Belgium (September) ..	250,300 ..	274,100

It will be noted that this table shows increases for Britain and Belgium, but a considerable decrease for France, a heavy decrease for Germany, and a very heavy decrease for America. Bulking together the outputs of Britain, America, Germany, France, Belgium, Saar, Luxemburg, Italy, Poland, and Canada, the latest recorded month—September, October, or November, as the case may be—the fall was from an aggregate of 5,882,400 tons for the latest recorded month in 1930 to 4,071,200 tons in the corresponding month of 1931.

Imports and Exports.

For the latest single months recorded in 1931, compared with corresponding month in 1930, exports were as follows:—

Iron and Steel Exports, in Tons, for One Month.

	1930.	1931.
From Britain (November)	203,900 ..	195,700
Germany (September) ..	342,100 ..	378,600
France (September) ..	323,000 ..	286,400
Belgium with Luxemburg (September)	327,800 ..	307,400
United States (September)	123,500 ..	59,800

Imports by the same measure have been as follows:

Iron and Steel Imports, in Tons, for One Month.

	1930.	1931.
Into Britain (November) ..	209,800 ..	379,300
Germany (September) ..	82,000 ..	56,000
France (September) ..	30,100 ..	25,000*
Belgium with Luxemburg (September)	51,400 ..	40,500
United States (September)	38,100 ..	30,200

* August.

Thus, whilst the four chief foreign iron and steel countries put together are importing only 151,700 tons per month, Britain is importing 379,300 tons, and whilst the four foreign countries are exporting 1,032,200 tons in a month, Britain is sending out only 195,700 tons. In other words, Britain has an adverse balance, whereas the others have favourable balances. The fact becomes all the more striking when it is observed that we have to import and pay for more food than the other four nations combined.

Value of British Iron and Steel.

From the preliminary report of the 1930 Census of Production, as given in the *Board of Trade Journal*, it is easy to get interesting and significant facts, if the figures are viewed in light of the altered cash

values, as compared with the year of the previous census.

Blast-furnace results are given thus :—

British Blast-furnaces.

	1924.	1930.
Value of output, £	36,572,000	23,542,000
Cost of materials used, £	31,315,000	19,660,000
Net output, tons	5,257,000	3,882,000
Average number of workers employed	26,970	19,036
Net output per worker, £	195	204

British Steel Smelting Works and Rolling Mills.

	1924.	1930.
Value of goods made and work done (gross output), £	119,342,000	82,114,000
Cost of materials, £	87,941,000	56,831,000
Paid for work given out, £	495,000	483,000
Output, tons	30,906,000	24,800,000
Average number employed	152,672	132,816
Net output per person employed, £	202	187

The horse-power of prime movers at blast-furnaces, steel smelting works, and rolling mills was 1,680,708 in 1924 and 1,907,538 in 1930. Average price of pig iron was £4·4 in 1924 and £3·4 in 1930; of steel ingots, £6·6 and £5; of sheet bars, £7·7 and £5·7; blooms, billets, and slabs, £8·6 and £7·3; and steel castings, £46·6 and £38·2 per ton. Price declines between 1924 and 1930 were ranged from 9 per cent. in steel bars, rods, angles, and shapes, to 31 per cent. in the case of hoops, strips, and tubes.

Present Position.

After a little betterment in November, business receded as Christmas approached. Up to the middle of December the volume of inquiries remained good, but the volume of contracts placed was not so good. Stocks of pig iron decreased, export trade being assisted to some extent by the altered value of sterling. On the other hand, day-by-day ups and downs in exchange tended to handicap transactions. The year ended in uncertainty. The flood of Continental iron into this country appeared to have been arrested a few weeks ago, but there was a resumption of business in this line because of the knowledge that no tariff was to be imposed on iron and steel by our Government in the immediate future. The same remarks apply to crude and semi-steels. But it is not likely that December imports of iron or steel will be nearly so heavy as those of November, or even so heavy as those of October. Imports were pressed in October and still more in November, because of the possibility of a British tariff. December import figures will, when published, show recession. The finished steel trade remained slack as regards heavy products, but there was improvement in light goods. The year closed with a feeling of moderate optimism, tempered by knowledge of the still unsettled world financial and political affairs.

Foreign Conditions.

United States.—The American steel trade remains a spectacle unmatched in any other country. Natural resources and productive capacity are far greater than those of other nations—greater, indeed, than the combined resources and capacities of European countries. But the United States cannot export any considerable tonnages of iron or steel to any country except next-door Canada. Costs of production and transport put America nearly out of the international competitive race. Whereas the total inclusive transport charges—charges for assembling raw materials at works and carrying finished products to ports—amount to £3 per ton in America, they average only about £1 10s. in Continental Europe and barely £1 in Britain, because of the shorter and cheaper rail hauls on this side of the Atlantic. Furthermore, the depression in the home market will last much longer in the United States than in other countries. The demand for railway steel, which for many years was enormous in the States, is no longer remarkable. The country is well furnished with railways, and very little will be expended by the railway companies for many years. Secondly, the railway engineers have demanded a far better class of steel than they got from the manufacturers in days gone by—steel which will last much longer. This involves greatly reduced tonnage. Thirdly, the shipbuilding industry of the United States, which was boosted up to a much higher level of production than the British shipbuilding industry between 1916 and 1921, has dropped down to insignificant dimensions, because of the excessive cost of assembling iron and steel-making materials, of carrying steel from works to shipyards, and of building and manning and provisioning ships under the American flag.

Germany.—Germany's output of steel, which was almost as great for the smaller Germany in 1929 as that of the greater Germany in 1913, has been reduced by more than one-half within two years—from an average monthly production of 1,332,700 tons in 1929 to 593,700 tons in October, 1931. Exports are maintained—378,600 tons for September—well by means of bounties and subsidies, but the home demand for steel—railway, shipbuilding, and other steel—has dropped to the lowest level for many years, because of financial and political considerations. The German home demand will not revive until Germany obtains release from foreign loan and reparation payments, or gets some more foreign loans or credits. Then, as on previous occasions, industrial Germany will make herself active.

France.—France continues to export ten times as much iron and steel as she imports—the result of protection against outside competition and cheap labour on goods for marketing abroad. In no month last year did imports into France reach 40,000 tons. In no month did exports fall so low as 250,000 tons. In August, the latest fully reported month, France imported only 24,900 tons of iron and steel, but exported 315,300 tons. The home demand in France is slack as regards purely commercial transactions; but the immense defensive works of the Government give great employment in the steel works; warship building continues on a good scale; and there is a measure or proposal before the French Parliament to stimulate the shipbuilding industry. That would mean not only more work in French shipyards and steel works, but less shipbuilding in Britain on French account. France is, even in this time of depression, producing 50 per cent. more pig iron, 75 per cent. more steel, and exporting six times as much iron and steel as in 1913.

Belgium.—Depression is pronounced in Belgium. The great demand for steel inland which prevailed from the end of the war until recent months, to repair the great damages of the war, has ceased to operate. Belgium wants little steel now for constructions at home. The export trade is not profitable. Relatively to output, Belgium exports more than Britain or any other country. Half of her output is exported. Against an export trade in iron and steel of 1,500,000 tons a year before the war, she now enjoys—is doing so to-day—an export trade at the rate of 3,500,000 tons a year.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RAIL-CARS.

SIR,—I feel sure that a large number of your railway engineering readers have read with pleasure and interest the very excellent description of the trial run of the "oil-electric" rail-car, which is illustrated in the descriptive article in your issue of December 18th.

With the exception that it is fitted with a more powerful internal combustion engine, the general design reminds me of a test I made some twenty-six years ago—with Mr. Wilson Worsdell's permission—on the North-Eastern Railway, on a similar design electrically driven rail-car. The engine was of 90 B.H.P. at 420 r.p.m., and drove a Westinghouse generator of 55-kilowatt capacity at 500 volts. This was controlled on the normal "Ward-Leonard" system, and supplied two 55 B.H.P. Thomson-Houston traction series-wound motors, each driving one of the two axles on the bogie directly under the generating compartment, just the same as has been adopted in this more modern application of the old-time system. A thirty-five cell battery of accumulators—which were charged by the exciter, which was belt-driven from the fly-wheel of the engine—motored the generator for starting the engine. The two traction motors could be coupled either in series, or parallel, and the speed control was further accomplished by field variation by means of the exciter. The top speed on the level was 40 m.p.h.; but, owing to the characteristics of the "series" wound motors employed, the acceleration was poor. The weight of the car was 35 tons, and the seating capacity was fifty-two passengers. The car ran very sweetly, with very little noise or vibration, but was rather slow on the grades encountered. It could, however, put up quite a lively speed when running "down" grades. I notice that the weight per passenger seat of the new car is 1586 lb., whilst the old car was only 1425 lb.

It is interesting to see that on the climb from Newcastle-on-Tyne to Blackhill, that between Rowlands Gill and Blackhill the speed was approximately from 20 to 30 m.p.h., whilst on the down-grade from Chester-le-Street to Low Fell—downhill—the speed touched 64 m.p.h. During the course of many years of research development in railway traction work, I have always endeavoured to cut out the ruling grades, by providing means by which a high average speed is obtained, rather than rely in time-table keeping, by excessive speeds on down-grades and limited speeds on up-grades. I do not believe that it can be "commercially" accomplished by other than a means of energy recuperation on down-grades, and storing same so that it may be used to supply the extra power required on our higher up-grade car speeds. The point is wonderfully clear, when the excellent diagrams are studied, resulting from the trial run of the "oil-electric" rail-car referred to in your instructive and interesting article.

As the merits of the "steam" rail-car have been mentioned, may I draw respectful attention to the fact that first-class steam rail-cars were made in this country thirty years ago, carrying 5500 lb. of water, and 3360 lb. of fuel, producing a tractive effort of 9792 lb. and running at a speed of 40 m.p.h. on the level—and, of course, easily 60 m.p.h. downhill—seating comfortably seventy passengers with baggage space, and of high-class finish for a total weight of 1840 lb. per seat.

To-day, light steam cars are made with a weight of 1282 lb. per seat, seating forty-six passengers. An "oil-electric" rail-car in Canada seating thirty-seven passengers and baggage space weighs 3694 lb. per seat. A petrol-electric rail-car seating fifty passengers, 60ft. overall length, and fitted with a 250 B.H.P. engine, weighs 1800 lb. per seat, and a similar rail-car but seating ninety-two passengers, 72ft. long, with same power engine, weighs 1208 lb. per seat.

It is no good ever talking about a rail-car service at less than an average speed of 50 m.p.h., and this is perfectly possible and reasonable in the light of recent developments in this direction. Besides a large number in successful operation in America and Canada—where extreme low temperatures are experienced and dangers of freezing exist—some 250 battery-electric rail-cars are in very satisfactory operation on the German railways, and a whole batch have been recently put to work on the Charente Railways in France, where they continue to give great satisfaction, running some 150 kilomes. on one charge, and the speed of the railway has been increased by about 65 per cent., compared with the old-time steam traction. Current for charging purposes is, of course, very cheap now in France, and the battery-electric cars have shown great reliability and economy in operation, besides providing greater comfort to passengers, besides complete absence of risk of fire, smoke and effluvia. Besides the railway company has no trouble about procuring its essential operating energy, which can be used for so many different purposes on modern railway operation.

London, December 29th. WILLIAM P. DURTNALL.

THE NEW CUNARDER.

SIR,—There must be a considerable amount of correspondence from the general public on this matter that I feel must be somewhat embarrassing to the officials concerned. May I, therefore, ask your kind permission to publish the following in the hope that it will draw professional opinion on the subject?

The competition in large hull building with its enormous costly decorative finish—staggering alike to the insurance world and management—seems to me to be but an incentive to go one better.

Now, Sir, any attempt to compete in speed with these large hulls can only be done at the expense of unremunerative working, therefore to come at once to my point, would it not seem desirable to cut this new hull in two and use the best ingenuity of man to push each of them through the water at such speed as will get the traveller on the British boat *there* long before the other fellow, and as far as my experience goes in general, I feel persuaded that if such were the case the very bottom would be knocked out of the mammoth class of ship in favour of "the get-there-quickest" class, and when one knows that this can be done with the maximum of safety, why not?

As to any thought of narrowness or want of Imperialism in this view, I am content to feel in myself that I would rather rejoice in my fast British greyhounds and blue ribbons than what seems to be the present craze to produce *a* greyhound and *a* blue ribbon; and if a slogan would help, perhaps "Less luxury and more speed" might not be out of place. Apologising for intruding on your valuable space. WILLIAM T. ANDREWS.

Chingford, December 23rd.

THE INSPECTION OF WELDS.

SIR,—In the report of the Dagenham railway accident inquiry—*The Times*, December 23rd, 1931—mention was made of a defective weld in a draw-bar, and it was suggested that inspection of such structures for flaws was a difficult, if not an impossible, matter. May I point out that the use of radiology—either X-rays or radium—preferably X-rays, has been so developed that it is now possible and perfectly practicable to examine steel structures up to a thickness of 3in. and to show flaws of dimension of some 0·5 per cent. of the thickness of the specimen I do not know whether the articles mentioned in this inquiry would lend themselves to this type of inspection, but it would appear that some consideration should be given to the method, particularly in the case of vital structures.

V. E. PULLIN,
Director of Radiological Research,
Research Department, Woolwich.

December 12th.

WEATHER conditions affect engineering activities in many directions, so the following notes, taken from *The Times*, by M. J. W. Sandstrom, of the Meteorological and Hydrographical Society Institute of Stockholm, are of interest:—When in the summer of 1928 information was received from the other side of the Atlantic that the water of the Gulf Stream was unusually warm, it was observed during the next winter that this warm water had reached the southern point of Iceland, causing low atmospheric pressure, while high pressure was observed over Northern Russia, accompanied by clear cold weather. That winter was one of the coldest in the annals of Sweden, holding the country icebound for an unusually long period. In the summer of 1929 the warm water belt had moved north of Iceland, bringing with it the same low pressure conditions. Now the southerly winds from Spain and the Azores brought their warmth to Sweden direct, causing one of the warmest winters on record. In the following summer—1930—the warm water current had reached the Arctic Ocean north of Norway. That year much melting was observed at the edge of the great Polar ice region, making possible the recovery of the bodies of the members of the Andrée Expedition. The westerly winds caused a warm autumn that year, but the warm water current moved north and east towards Spitzbergen and Franz Josef Land, bringing with it low atmospheric pressure. The wind consequently turned more and more, and finally became north-westerly, bringing the chilly air of ice-covered Greenland to Sweden. The spring and summer of 1931 were, therefore, unusually cold and unpleasant.

Railway and Road Matters.

DURING the first three months of its accelerated running, the "Cheltenham Flyer," which is booked to cover the 77½ miles between Swindon and Paddington in 67 minutes, ran a total distance of 6008 miles in 5233½ minutes. That is only 7½ minutes over the total booked schedule for the seventy-eight runs.

WHAT the Metropolitan Railway Company stated to have been the worst hold-up experienced for a number of years occurred at Baker-street Station on the evening of Wednesday, December 23rd. The mishap, in itself, was only a minor one, but it led to all the roads on the St. John's Wood side of the station being blocked, so that no trains could enter or leave.

WE are asked by the L. and N.E.R. to say that a statement in this column on December 25th to the effect that "all the creosoting work for the Southern Area of the London and North-Eastern Railway is being concentrated in a new yard just opened at Bo'ness" is incorrect, and likely to give the impression that the company is closing its creosoting depôts at various places.

ANSWERING a question addressed to him on December 9th, the Under-Secretary of State for Air said that he was not prepared to make representations to the railway companies to have the name of every railway station painted on the roof. Many stations are situated in thickly populated areas and so the names would easily become obscured and pilots might be tempted to fly dangerously low in order to read them.

ONE of the latest developments in the use of containers for conveying traffic by road and rail combined, without transhipment, is their employment in the carriage of coal. In the *Great Western Railway Magazine* for December there was an illustration showing six containers, filled with coal, being transported on a flat truck. They are loaded at the colliery and unloaded at destination and, among other advantages, there is less breakage of the coal.

THE recent fatal accident at Dagenham adds interest to the remarks, quoted herein on October 23rd, in Colonel Mount's report on the railway accidents during the year 1930. The collision at Dagenham originated from a broken draw-bar. There were 5520 failures of coupling equipment in goods trains reported in 1930, of which 3180, or 57·6 per cent., were due to the pulling out or breakage of draw-bars or hooks. On the general question of coupling failures the report observed that the figures continued to prove that the chief liability to failure was to be found in weakness of draw gear and that the chief class of weakness was in the pulling out or breakage of draw-bars or hooks.

THE annual report of the Commissioner for the Commonwealth Railways of Australia for the year ended June 30th last showed that whilst the earnings, as compared with the year 1929–30, fell from £404,136 to £309,134, the expenditure was reduced from £554,581 to £458,621, and whilst the earnings per train mile had a drop from 10s. 10d. to 9s. 6d., the working expenses were reduced from 14s. 10½d. per train mile to 14s. 1d. The main member of the Commonwealth Railways is the East-West Transcontinental—1052 miles long—and of it the report says that from the time of the opening of the railway—in 1917—until the close of the year ended June 30th, 1929, there had been a gradual increase in the number travelling, the maximum number of through passengers—31,109—being reached in the year named. During the succeeding year the number dropped to 25,650 and for the year under review the number was 15,527, not quite one-half the number that travelled in 1929; 15,527 is the lowest number for a full year since the opening of the railway.

THOSE who remember the agitation that prevailed, some twenty or thirty years ago, in certain quarters for the adoption by British railways of the 40-ton wagon may be amused by the naïve confession made recently by Mr. Frank Pick in his presidential address to the Metropolitan Graduate and Student Society of the Institute of Transport. Mr. Pick, at the time we are thinking of, was on the North-Eastern at York with Sir George Gibb, who had, on his return from a visit to America, brought back a large mass of data upon the use of the large-capacity wagon in the United States. This was turned over to Mr. Pick to digest and see what sort of a case could be made out for its use. Knowing that Sir George desired that there should be a good case, Mr. Pick said that he certainly made one. Proceeding, he remarked, however, that "when one looks back on the efforts which were made in 1900 to justify large-capacity wagons, and when one looks at what is the most popular unit of transport to-day, one is bound to confess to feeling a little shocked."

THE Ministry of Transport inquiry into the collision of December 18th near Dagenham Dock Station on the Tilbury section of the London, Midland and Scottish Railway, was held on December 22nd by Lieut.-Colonel Mount. It will be remembered that in this case the 9.25 p.m. passenger train from Fenchurch-street to Tilbury ran, in a particularly dense fog, into a portion of a goods train which had become detached from the front part of the train when running between Barking and Dagenham Dock Station. One passenger and the guard of the goods train were killed. The coroner's inquest was held the following day, and from the evidence given at the two inquiries we are able to reconstruct the facts that led up to the accident. The goods train consisted of thirty-eight wagons and a brake van, and came to a stand momentarily at Dagenham Dock Station home signal. Presumably, when the train restarted the draw-bar of the twenty-ninth wagon broke and the train left ten wagons and the van behind. The signalman, owing to the fog, could not see if the train had the required tail lamp to indicate that it was complete. He said: "I was under the impression that the train was complete and I gave 'all-clear' to the passenger train." It was at one time thought that the guard had gone back to protect his train and was run over and killed when putting detonators on the rail, but it would appear that he was killed when alighting from his van as the passenger train struck the obstruction. From evidence given by Mr. Lemon it seems that the draw-bar was comparatively new, but had an unsound weld, which could not have been detected by any ordinary inspection. The coroner's jury returned a verdict of "Accidental Death."

Notes and Memoranda.

THE Engineering Experiment Station of the Ohio State University has recently published a bulletin on the "Relative Heat Transfer through Refractories." It contains a great mass of useful information and can be purchased for 50 cents.

ACCORDING to some investigations carried out in America it is possible, in belt driving, to transmit 100 lb. pull per inch of width with a four-ply rubber belt running on a paper pulley and with an angle of contact as low as 90 deg. without undue tightening of the belt.

WE have occasionally had to refer to the failure of the blow-down arrangements of boilers, but never to such a one as we have just heard of from America. The plant was in such a cold situation that sometimes the blow-down pipe froze up solid after a blow-down, and no more water could be passed. The trouble was overcome by ridding the piping of water after a blow-down by a connection with a compressed air service.

THE equipment in the pulverised coal plant and all steel work at the Copper Cliff refinery in the Sudbury district of Ontario is aluminium painted, so that any coal dust can be readily detected. A central vacuum cleaning system has been installed with outlets conveniently located about the plant. The plant is vacuum cleaned each day, and its condition is proof that a pulverised coal plant can be made just as clean as any part of a power station.

THE Ariel dam of the Inland Power and Light Company on the Lewis River, Washington, 32 miles north of Portland, Oregon, creates a lake 12 miles long. The dam, which is a variable radius, constant angle, arch type, is 1251ft. long on the crest and stands 313ft. high from the lowest point in the foundation to the top, and extends 123ft. below the bed of the stream. The power-house, built for two units with foundations and penstocks set for two more, now contains one 45,000 kW generator.

COAL-BURNING central stations have, says *Power*, adhered largely to one type of firing, because of the desire to avoid the complications of dual systems and the ability of some modern stokers to be operated at high ratings as readily and as economically as pulverised coal furnaces. While the application of dual firing under American conditions thus appears to have certain limitations, engineers cannot afford to overlook its possibilities and to apply such a system wherever conditions warrant.

THE Sangamon River once supplied Springfield, Illinois, with pure water, without treatment. Twelve years ago its bacterial content had risen to 10,000 per cubic centimetre, and a modern water purification was installed. Now, according to Mr. R. E. McDonnell, the bacterial content of the raw water often rises to 100,000 per cubic centimetre—a point of dangerous saturation—and, even with all the safeguards of a modern purification plant and the best of skill in its operation, that city has felt justified in recently voting 2,500,000 dollars for a new source of water supply, an artificial lake protected from pollution.

THE transport by rail of hydrogen peroxide in a specially constructed tank car is reported by the *Oil, Paint and Drug Reporter* of New York to have been successfully accomplished by the Buffalo Electro-Chemical Company. The scheme is reported to have effected a substantial saving in transportation costs, in comparison with the customary packing of peroxide in carboys. The tank car, which was constructed by the General American Tank Car Corporation, is built of three large plates of a new aluminium alloy, which contains copper, manganese and titanium as impurities only. One tank car is now in regular service, and others are being built. Each car has a capacity of 8000 gallons.

THE mangeross electrode has been developed by research in the laboratories of the Quasi-Arc Company, with the object of producing an electrode which will deposit a weld metal, giving resistance to wear and abrasion, equal to that of manganese steel, and, in addition, strength and toughness. The metal deposited is an austenitic steel, tough and comparatively soft, but rapidly "wear hardens" when subjected to abrasion or hammering. It is claimed that it is also possible to make strength welds on manganese steel as the mangeross weld metal is tough and has no tendency to hot-crack when deposited in the proper manner. The Brinell hardness number of the metal after cold working is of the order of 450.

AT 11 o'clock on Saturday morning, December 19th, the Yorkshire Electric Power Company received a telephone message to the effect that a steam engine at Messrs. Eastwood Bros., woollen manufacturers, Thirstin Mills, Honley, had broken down and was seriously damaged, and as the mill was exceptionally busy and working overtime the company was appealed to for an endeavour to provide electric drive for the machinery first thing on Monday morning. Arrangements were immediately put in hand and before 10 o'clock on Sunday evening supply was available to the mill ready for running on Monday morning. The Yorkshire Electric Power Company also undertook the consumer's installation, comprising some 90 horse-power and all the wiring.

ACCORDING to the *Chemical Trade Journal*, Drs. H. A. Auden and W. P. Joshua have evolved a process for the transformation of wood cellulose into fermentable products on an industrial scale. With an improved method they have succeeded in obtaining 35 to 40 gallons of alcohol per ton of dry sawdust. This makes the process commercially profitable where the cost per ton of dry sawdust is not more than 5s., and a supply of 200 tons per twenty-four hours is available. The method was worked out in the research laboratory of the Distillers' Company, Epsom. It consists in forcing acidulated water—containing two parts per thousand of sulphuric acid—at a temperature of 180 deg. Cent., and 12 atmospheres pressure, through sawdust packed in lead-lined vessels. Under these conditions 45 to 50 per cent. of the sawdust is changed into fermentable sugars. The molasses thus obtained are fermented with yeast in order to obtain alcohol. A preliminary treatment of the sawdust with superheated steam has been found advantageous, because it removes resins and other undesirable constituents, and also helps the hydrolysis.

Miscellanea.

IT is proposed to organise a big hydro-electric scheme for the State of Hyderabad.

THE Corporation of Stoke-on-Trent is considering the synchronisation of all public clocks.

SEVERAL tramways in Paris are to be taken up and replaced by motor omnibus services.

A DEPOT for the service of owners of Morris motor cars has just been established at Warsaw.

IT is proposed to hold an International Congress of Transoceanic Airmen in Rome next May.

THE Great Western Railway has decided to purchase 227 road motor vehicles, at a cost of £92,000.

THE tire factory at Oakville, near Toronto, which has been shut down for five years, is being restarted.

A PLANT for the manufacture of window glass, from local materials, is to be put up in Egypt by the Government.

A UNITED STATES firm proposes to put up a factory for making electrical storage batteries in Winnipeg, Manitoba.

A NEW ore-dressing laboratory was opened at the University of Birmingham on December 16th by Sir Robert Horne.

IT is proposed to construct a deep-water port at the mouth of the Rio Grande, on the border of the United States and Mexico.

IT is proposed to put up a plant for milling 1000 tons of ore a day at the Beatty Gold Mine in Ontario. The ore is said to have an average assay value of 3·09 dollars per ton.

IT is announced that the Westinghouse Company, of America, has evolved a searchlight weighing only 50 lb., operated by a 250-watt lamp, which is visible at a distance of 50 miles.

THE new nitric acid plant at the Modderfontein Dynamite Factory will save the importation into South Africa of 18,000 tons of sodium nitrate and 7000 tons of sulphur annually.

A NEW company has been formed in South Africa, under the title of the Aircraft Operating Company (Africa), (Pty.), Ltd., with offices in Johannesburg, for the purpose of carrying out aerial surveys.

IT is reported that a large synthetic ammonia plant, working on the process invented by Dr. Holmboe, of Norway, is to be put up in Italy. The necessary power will be produced hydro-electrically.

A COMPANY with a capital of some £1,000,000 has been organised in Japan for the manufacture of artificial nitrates as a by-product of coking processes. It is intended to work on the Claude system and to produce about 30,000 tons of sulphate of ammonia annually.

IT is proposed to construct a bridge between the islands of Masnedö and Falster, on the Danish Continental route. The bridge would be 3270 m. long—the longest in Europe—have a road width of 18ft., a single line railway track, and a head room of 85ft. The cost is put at about £2,000,000.

IT has been decided by the Government in Nanking, China, that there should be established in that city a Central Machine Works, at a total cost of about £300,000. That amount is to be derived from the Boxer indemnities and the plant is to be concerned with the manufacture of steam boilers, refrigerating plant, and such like material.

THE South Halsted-street lift bridge over the Chicago River, built in 1894, is to be replaced by a double-leaf bascule bridge. This bridge, which was designed by J. A. L. Waddell, has a span operating between steel towers, 215ft. high, and has maximum headroom when raised of 155ft. The bridge has become too light for present traffic and loads.

EXHAUSTIVE experiments, now nearing completion, have been conducted in the past year or two by the South African Railways in regard to the proofing of the canvas used for manufacturing tarpaulins in order to improve the waterproof qualities, and at the same time give a longer life to the canvas, and thereby effect further substantial economies. The "life" of such canvas is also being closely watched with a view to selecting the canvas which gives the most economical results.

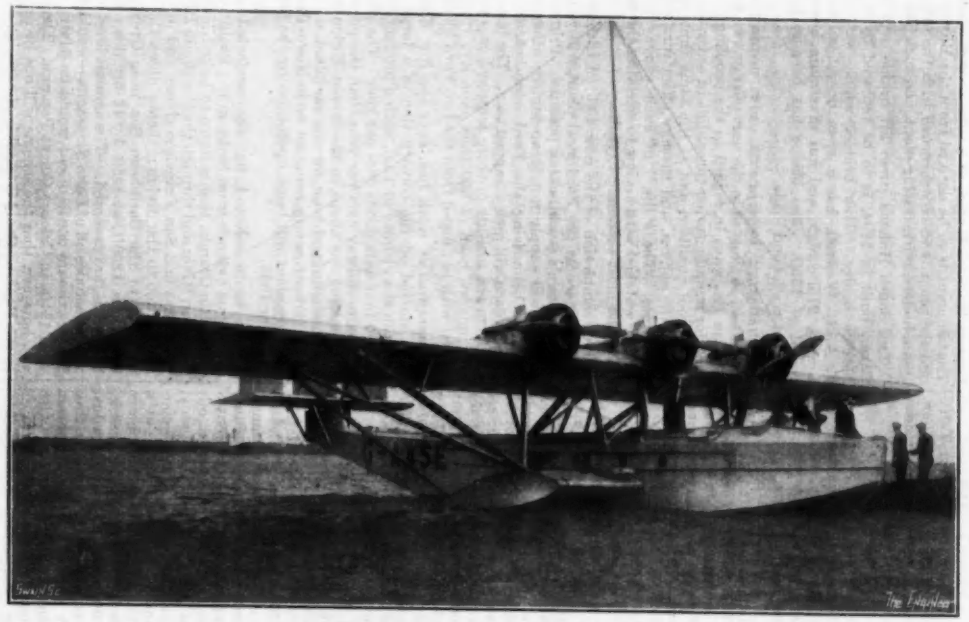
THE completion of the new 400-ton tilting open-hearth steel furnace at the Ford steel plant will radically revise the company's steel making practice. Primarily, the new furnace will supply hot scrap for the other nine 100-ton furnaces comprising the Ford open-hearth department. The furnace will melt scrapped cars. The hot metal resulting from the melting of these scrapped cars will go to two new mixers, each of 600 tons capacity, where it will be mixed with hot metal from the two Ford blast-furnaces.

PRELIMINARY work has, says the *Far Eastern Review*, been started on the construction of a large car-building plant in the vicinity of Tagi, with a productive capacity of 55,000 four-axle goods cars per year. The plant will turn out more railway cars per year than the production of all the existing car shops in the Soviet Union put together. The metallurgical base for the car plant will be the new metal industries now being set up in Novo-Tagil. The car-building plant will begin operations by the first quarter of the year 1933.

THE route selected for the projected canal across Nicaragua extends from Brito on the Pacific up the valley of the Rio Grande, thence down to Lake Nicaragua, up the San Juan River and through the Conchuda Hills and across the Danta and San Francisco rivers, and up the valley of the Limpio to the divide; thence down the valley of the Descado to the Caribbean Sea near Greytown. Three twin locks, 1200ft. by 125ft. by 42·5ft. deep on each side of the divide, are proposed. The summit level of the canal—which includes all of Lake Nicaragua—would be at El. 110. The maximum depth of cut would be 344ft., as compared with 494ft. in Culebra Cut at Panama. The latest reports are, however, that the scheme will not be proceeded with, as the Panama Canal is capable of carrying all traffic to be expected by 1970.

SOME BRITISH AIRCRAFT OF 1931

(*For description see page 2*)



SUPERMARINE ALL-METAL "FLYING YACHT"

VICKERS "VILDEBEEST" TORPEDO BOMBER SEAPLANE

VICKERS-ROLLS-ROYCE TYPE 163 FOUR-ENGINED NIGHT BOMBER

FAIREY "GORDON" GENERAL PURPOSE MACHINE

The Engineer

JANUARY 1, 1932.

VOL. CLIII. No. 3964

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TWO FOUR-PAGE SUPPLEMENTS—SHIPBUILDING, BRIDGES, FLYING MACHINES, MOTOR SHIPS, STEAMSHIPS, WARSHIPS, ELECTRICAL ENGINEERING

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A Retrospect.

THIS is likely to be the shortest general review of the events of a year that has appeared in the columns of THE ENGINEER for many a long day. It would not be true to say that there is nothing to record in the realm of engineering; but what there is is tinctured with a sable hue, and redolent of politics. It must be admitted that 1931 was the worst year for industry that the present generation has known. We are not sorry to turn the bolts upon it, and to open the gate upon a new one with this first day of January.

The event of the past year which overshadows all others was the complete rout of the Labour Government in October, and the establishment of the National Government in its stead. The defeat of Labour may be attributed to two causes, both of which affect the engineering industries. The first was its extravagance which led directly to a burden of taxation that bore very heavily upon producers, prevented developments and improvements which should have taken place, so raised manufacturing costs that competition in the open market was made extremely difficult, and culminated in a vision of national bankruptcy. The second cause was the overwhelming desire of industries for the imposition of protective tariffs. With the exception of the Prime Minister and one or two of his colleagues in the Cabinet, the Labour Party refused to admit that there was any real financial crisis, and opposed, with a vigour unsurpassed by that of the staunchest of Tories, any change in the fiscal system of the kingdom. The party failed signally to recognise the will of the people, and was virtually swept out of existence. A new party, pledged wholeheartedly to financial reform and—with some reservations—to Protection, took its place. From August 25th to October 27th, this party ruled without a mandate, but when it went to the country its policy was confirmed by a ballot which gave it a majority of no less than four hundred and ninety-seven.

Unfortunately, nothing could be done to reduce taxation. The trade balance was on the wrong side, and there was a deplorable certainty that the Budget could not be balanced. Hence a supplementary Budget increasing the imposts on several commodities had to be passed. At the same time the income tax was raised by sixpence in the pound, and so extended that more people came within its ambit. Despite this action, which was taken before the General Election, foreign confidence in British financial stability waned, and ultimately the pound sterling had to be taken off the gold standard. Its exchange value dropped, and foreign markets at once improved, but the revival was countered by the increase, particularly in France, of protective tariffs. At the same moment, all European countries and America found themselves in financial difficulties, and the flicker of new life which followed the coming of a strong British Government was almost extinguished. Not quite. A movement in the right direction had taken place, and, though it was unable to gain impetus, trade certainly improved towards the end of the year, and gave rise to brightening expectations for the not distant future.

The position is, indeed, one at which the gods must laugh. Here is the world, no poorer than it was ten years ago, full of people with unsatisfied desires for manufactured products; here is the capacity to provide them with what they want; and here are harvests that could supply them all with the fruits of the earth in abundance. Despite all this, poverty is knocking at unaccustomed doors, millions of men are unemployed, millions are going hungry, and millions are unable to sell their goods and to buy from others. Why such things should be, it passes the wit of men to say. Explanations there are in plenty, but not one of them gets over the fundamental fact that all could be employed, all could be satisfied, all capacity could be used, if only the rapid circulation of money could once more be started. International confidence would appear to be the key to the long-deferred restoration of industries. Unfortunately, the conditions are such that economy is essential at the very moment when extravagance is desirable. Hence the world is at an impasse. We are, however, profoundly confident that a way will be found or forced through the block before long, and that a fundamentally illogical condition will be removed, and the activity of industries in all nations be restored.

One of the natural consequences of the stultification of trade is the decrease in traffic of all sorts. The state of the shipping industry throughout the year was deplorable, and that of the railways not much better. Ships were laid up by scores and the Transatlantic transport of passengers dwindled to small proportions. That fact, combined with others, led to the most spectacular and most deplorable event of the year in the engineering field. Great Britain was hoping with full confidence to win back the Blue Riband of the Atlantic when the great Cunarder under construction on the Clyde entered into competition with the German holder. Her vast hull is nearly complete and her equipment is far advanced. In a few months she would have taken the water, and about a year later would have been ready for service. Her place upon the stocks would have been filled by a sister already projected. The eyes of the country were centred with pride on the new liner, and when a few weeks ago the announcement was made that the Cunard Company felt itself compelled to suspend all work upon her, general consternation ensued. Efforts of various kinds were made during the last fortnight of the year to provide means of proceeding with the construction. These efforts oscillated between a demand that the Government should "do something" and the more practical, if no more useful, gesture of sympathisers who sent their little contributions to the Cunard Company. But as time passed it became evident that until Transatlantic commerce improves there is very little likelihood indeed that the Cunard Company will feel itself justified in proceeding with construction. The fact is that whilst means for completing the ship could be found the prospect that she could be run with financial profit is still remote.

We fear that the rather gloomy picture which we have painted gives the true impression of the year as a whole. But bright spots were not wholly wanting, and the courage of British engineers was not broken by their reverses. As we show in our technical pages, a great deal of good work was done. Much less than a normal year would have to show, but enough to keep our hearts up. Several notable liners were constructed, the electric system of propulsion established itself, and progress was made towards the development of a marine oil engine which might justly be described as British. The continued encouragement of electrical engineering which is given by the "Grid" helped not only that industry, but that of the large steam turbine and boiler builders. Good progress was made with the super power-house at Battersea, in connection with which the announcement was made that all doubts about the efficiency of the gas-cleaning plant had been removed. The agitation against the construction of the power-house will have served a good purpose if it results in the production of a not too costly method of reducing one of the principal objections to the concentration of great power.

Of the steam locomotive there is little or nothing to be said; not one of the great railways having produced a new type. Nor did anything very striking occur in road transport. The honours in the realm of transport really go to the air, for, although the progress of the dirigible came to a lamentable end with the disposal of "R 100" for scrap, the aeroplane industry made remarkable advances. It is now confirmed that the winning of the Schneider Trophy had a real industrial value. The prestige of British aeroplane and seaplane builders is world-wide, and big contracts were placed here by foreign Governments. It is a striking fact that of any given type of machine, hundreds are constructed nowadays in place of the tens a few years ago.

What little there is to say about shipbuilding for the British Navy is said elsewhere. This country's laudable intention to abide strictly by the Washington Agreement has reduced a once flourishing industry to almost negligible proportions.

The difficulties with which they found themselves faced did not deter British engineers from taking part in the usual Shows and Exhibitions, which were as numerous as usual, but possibly on account of the conditions, the intrinsic value of these numerous displays was even more freely questioned than in former years, and it is not impossible that some corporate action will be taken to obviate a redundancy which puts manufacturers to great expense without adequate return. One Association—that of the machine tool makers—has already gone so far as to decide upon the postponement of the Exhibition which should have been held this year. In that case action is to be regretted, for, owing to the regulations of the Association, British machine tools are not shown at general exhibitions, and as foreign machines are displayed in large numbers, it is feared that the British industry suffers.

Amongst Exhibitions which have taken a firm hold, that organised every two years by Mr. F. W. Bridges is likely to receive continued support. It opened in September last year, and on the whole did well. The annual Fair in Birmingham was also carried through with success, and the available area is being extended for the approaching display. But the most notable Exhibition of the year was that at Buenos Aires, which was opened in April by the Prince of Wales, and to which we devoted an Anglo-Spanish Supplement and many bi-lingual pages. Although it is impossible to say that it has borne fruit, one cannot doubt that it made a great impression in Latin America, and that with a trade revival the benefits of it will be felt.

During the twelve months many Reports by the Government, by Committees, and by influential bodies were published, several of them of an economical nature inspired by the conditions of industry, amongst which "The Industrial Situation," issued by the National Confederation of Employers' Organisations, may be particularly mentioned. A Report of another kind appeared in April. It was that of Lord Weir's Committee on the Electrification of Main Line Railways. In general terms, it recommended the electrification of all the railways of the United Kingdom at an estimated capital expenditure of nearly 261 million pounds. Were the scheme adopted, it would mean, almost certainly, the nationalisation of the railway systems of the land, and for that reason it, no doubt, appealed to the late Government, but the country is in no position to consider expenditure on so vast a scale, and no action has, so far, resulted, and none is in sight.

The year witnessed the death of one of the greatest pioneers in the realm of engineering, and the celebration of the centenary of one of the most fruitful of scientific discoveries. On February 11th Sir Charles Parsons died at sea. To him belongs the undying honour of having brought the steam turbine into useful existence. Many inventors preceded him, but he alone had the courage, the ability and the means to push experiments from moderate beginnings to lasting success. To no engineer does the world owe more than to him. It is remarkable that his death should have occurred only a few months before the celebration of the centenary of Faraday's great discovery upon which the whole art and practice of electrical engineering is founded, for the steam turbine was originally designed for the direct driving of dynamos, and still finds its widest field of usefulness in that service.

Turning our eyes from the past, let us consider

for a moment the prospect of the industries to which this paper is devoted. It would be foolish to pretend that it is already bright, but we are convinced by many little signs that it is brightening. The clouds that have hung over all branches of engineering for many months are beginning to break, and glimpses of sunshine are seen through them. There are more serious inquiries in the air, and a greater number are being converted into orders. Even a little change will make a great difference. The wheels of industry and trade have been retarded by a number of adverse events, some of which are well-nigh incomprehensible. But, in this country at least, the brakes are being taken off, and slight impulses are already being imparted to the tardy wheels. Once they begin to revolve freely again, we may expect them to pick up momentum fairly rapidly, for, in all truth, the whole world needs trade, and the only thing that is stopping it is its failure to begin. In the last weeks of 1931 high tariffs were imposed on many goods imported into the United Kingdom, and whatever the ultimate effect, the immediate result should be an improvement of those industries which have felt the greatest pressure from foreign imports. If in consequence there is a resuscitation of business in the protected industries, one may hope that it will spread to others, and set our feet towards a general revival.

The great needs of the world are confidence, both national and international, and the removal of financial obstacles and difficulties which are arresting the industrial life blood of several countries. Until these difficulties and obstacles are removed by the common agreement of all the nations concerned, it is almost vain to hope for a complete restoration of international commerce. If a solution of this tremendous problem is quickly found we are convinced that a world revival will follow upon its heels and that a period of great prosperity will be enjoyed by all peoples.

Locomotives in 1931.

FOR the first time in many years we find practically nothing to say in this annual review about locomotive developments on British railways. A small number of new engines went into service, but no new types made their appearance. The L.M.S. Railway decided during the year to equip all main line standard engines with exhaust injectors, to fit Lentz gear to five 2–6–0 engines, and test A.C.F.I. feed heaters on three 0–8–0 goods engines. The Southern is pursuing experiments with powdered fuel burning, and on the L. and N.E. Railway two 4–4–2 three-cylinder express passenger engines built for the North-Eastern in 1911 and 1913 have been rebuilt and fitted with boosters—see illustration. The booster is fitted to a bogie placed under the cab and carries the front of the tender and the rear of the engine. It was manufactured by J. Stone and Co., Ltd., Deptford, drives the front axle of the booster bogie, and is spring suspended. A gear ratio 1 : 1 enables it to give out useful work up to speeds of 30 miles per hour, and also facilitates engagement of gears. It is steam controlled, and can be cut in at any speed up to 30 miles per hour.

This is the first example of articulation between an engine and a tender in which the rear end of the engine and the front end of the tender are carried on a common bogie. The arrangement has greatly improved the riding of the engine and eliminated the relative lateral movement between the engine and the tender. The booster bogie has a side play of 4½in. each side, controlled by a pair of coil springs, having an initial compression of 2 tons.

A boiler of new design has been fitted to this engine. It has a sloping throat and back plate and a larger fire-box. The boiler pressure has been increased from 175 lb. to 200 lb. per square inch.

Owing to the increased boiler pressure, the tractive power of the engine has been increased from 19,300 lb. to 22,012 lb., or a total with booster of 27,012 lb. During recent tests with engine "No. 727" on a 300-ton train, a speed of 18 m.p.h. was obtained in 8 min. on a gradient of 1 in 70 with the booster out of operation. With the booster in operation a speed of 25 m.p.h. was reached in 5¼ min. On a level road the engine, with the booster out of operation, was able to start a load of 496 tons, the draw-bar pull being 9 tons. With the assistance of the booster a load of 746 tons was started, with a draw-bar pull of 12¼ tons. The weight of the engine and tender before conversion was 125 tons 17 cwt.; it is now 135 tons 8 cwt.

With regard to the Great Western there is nothing new to report in connection with steam locomotives, but we hear that the design of an electric locomotive is being studied. The year saw the last of the 4–4–0 type G.W. engines with 6ft. 8in. wheels—the "City of Truro" being presented in March to the Railway Museum at York.

Makers' Engines.

We have said above that there is practically nothing to be reported with regard to locomotives constructed in the works of the railway companies. Unfortunately the record of the locomotive building firms is almost the same. Their industry has suffered as much as, and possibly more than, any other branch of engineering, and there has been little opportunity for the development of new ideas. The interest in oil-propelled railway trains increased during the year, possibly as a direct counter to the Weir Report on Railway Electrification; but nothing of large size was produced, and it would seem that, for the present, powers not exceeding two or three hundred are all that British railways are prepared to consider. That limitation puts the oil main-line locomotive out of the question. Where oil propulsion is being used it is found in self-propelled vehicles of which the Armstrong-Sulzer mobile power-house may be taken as an example. One of these oil-electric coaches was tested on the London and North-Eastern Railway during December and was described in our third issue of that month. It will be put into regular service within a few days. As a reply to self-propelled oil-engined coaches we learn that a Sentinel steam coach with a remarkable high-pressure boiler is being developed.

Amongst steam locomotives the place of honour must be given to the Buenos Aires Pacific tank engine, which we described and illustrated in a Supplement in our issue of December 4th. It is a three-cylinder engine built by Robert Stephenson and Son, Ltd., of Darlington, and incorporates a new arrangement of the Walschaerts motion for the inside valve. The device is so obvious that we should wonder why it had been overlooked for so many years, were that not a common experience in mechanical inventions. All that Messrs. Stephenson have done is to place the combining (lap and lead) lever horizontal instead of vertical. One end is connected to the crosshead of the inside cylinder, the other is fulcrumed on a slide which is reciprocated, quite in the ordinary way, by the reversing link and excentric. The valve spindle connecting-rod is taken from an intermediate point on the lever. Those who examine a birdseye view of the gear in the issue of THE ENGINEER referred to above will see at once what a neat arrangement results and how the difficulties of an inside Walschaerts valve gear are surmounted.

Another engine presenting some features of novelty is the geared locomotive invented and constructed by the Avonside Engine Company, Ltd., and illustrated fully in our issue of November 6th. The engine, with either two or four cylinders, is of the vee type and is situated under the boiler barrel, with its crank shaft on the longitudinal centre. From each end of the crank shaft a cardan shaft runs to an overhead worm which drives a wheel keyed to the outer axle of a four-wheeled bogie at each end of the locomotive. Bevel gears have been used in America for this type of drive, but as far as we are aware worm gearing has not hitherto been employed. When arranged, as in this case, above the worm wheels it has the obvious advantage that the shafts can be carried in a horizontal line over the inner axles of the bogies.

Another interesting development connected with steam locomotives is a self-trimming bunker introduced by Beyer, Peacock and Co., Ltd., of Manchester. The coal is carried in a large, slightly tapered steel drum which rests between the usual tanks of the tender. By rocking or rotating the cylinder the coal is fed forward as desired and delivered at the fireman's feet. Whilst greatly reducing the labour of firing, it has the further advantage that it protects the coal from the weather and reduces the dust nuisance which occurs when friable fuel is employed. Thirty of these bunkers are being made for the L.M.S. Railway. The principal work done by Beyer, Peacock during the year was the production of Beyer-Garratt engines for the Bengal-Nagpur, the South African, and the Tanganyika railways, and the Sierra Leone Development Company, Ltd., but twenty-five tank engines for the Great Western and a couple of passenger engines and tenders for the Federated Malay States Railway were also constructed. None of these engines differ notably from earlier types.

We have already referred to the Armstrong-Sulzer oil-electric rail coach. Apart from it the locomotive work done by Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd., at Scotswood, presented no new features. Six oil-burning engines were completed for the Buenos Aires Western Railway, twenty-five pannier tank engines for the G.W. Railway, and a score of 2–6–0 three-cylinder engines for the L. and N.E. Railway.

The output of the North British Locomotive Works included ten Garratt type engines of large size for the Kenya and Uganda Railway; six mixed traffic locomotives for the Central Africa Railway; seven 2–8–2 goods engines for India; five engines for the Gold Coast Railway; and six "Mikados" for the Kailan Mining Administration, China. With the exception of the last-named none of the engines present anything out of usual practice, but the Chinese engines are fitted with mechanical stokers and thermic syphons. As the grate area is no more than 41·4 square feet, they must be amongst the smallest that are mechanically fired, it being generally held that up to about 70 square feet of grate area the use of the automatic stoker is not called for.

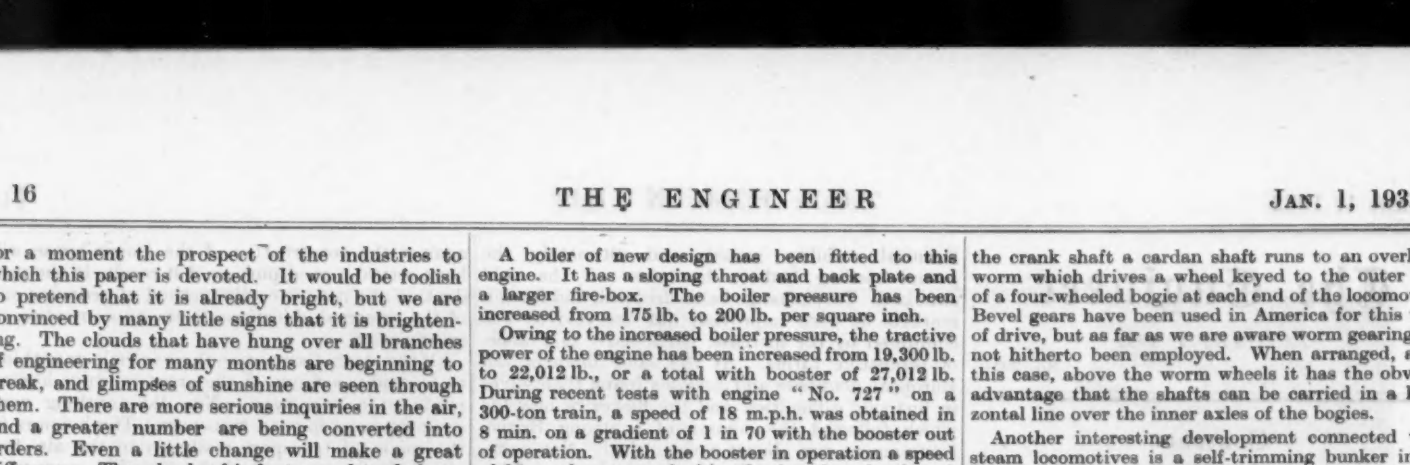
The Vulcan Foundry, Ltd., Newton-le-Willows, has what must be regarded as a good year to its credit. It completed forty-four I.S.R. standard "XA" 4–6–2, sixteen I.S.R. "XB" 4–6–2, and four I.S.R. "XD" 2–8–2 engines for India, and twenty 2–8–0 engines for the Buenos Aires Great Southern Railway. All these locomotives are for the 5ft. 6in. gauge.

The Hunslet Engine Company, Ltd., of Leeds, made a number of industrial engines of more or less standard type and for various gauges, and supplied a couple of side-tank engines with 16in. by 24in. cylinders to the Metropolitan District Railway.

W. G. Bagnall, Ltd., of Stafford, completed an order for fifty pannier tank engines for the G.W.R.; constructed three side-tank 0–4–0 engines with 12½in. by 18in. cylinders for the Bengal and North-Western Railway; and two side-tank engines with 11in. by 16in. cylinders for a 2ft. 6in. gauge plantation railway in India. Two locomotives for light and fast traffic on the Mysore Railway's metre gauge drew towards completion, and the delivery of eight tender engines for the Gwalia Light Railways began at the end of the year.

The Kitson-Still steam-oil locomotive underwent further improvement during the year and is now reported to be very satisfactory.

Peckett and Sons, Ltd., of Bristol, constructed two



L. AND N.E. RAILWAY ARTICULATED BOOSTER LOCOMOTIVE

special types of locomotives for service abroad. One has gone to the Christmas Island Phosphate Company, Ltd., at whose works it will work on a short railway of 4ft. 8½in. gauge with 500ft. curves. It is of the 0–8–0 type with a six-wheel tender, has cylinders 18in. by 26in., and coupled wheels 4ft. 6in. in diameter. The boiler is oil fired. It is interesting to note that three of the existing locomotives on the railway are of the Shay geared type, and it is hoped that the Peckett engines will give a faster service. The other locomotives constructed by the company are 0–6–0 side-tank engines ordered by the Cleveland Bridge and Engineering Company, Ltd., for work on the Lower Zambesi Bridge contract. A very diminutive engine was completed by the firm for a London gas company. It is of the side-tank type with inside 5½in. by 8in. cylinders and four coupled wheels 1ft. 8in. diameter. The headroom is so limited that the driver has to remain seated.

John Fowler and Co. (Leeds), Ltd., continued the development of their oil-engined locomotives. One was made for Petters, Ltd., of Yeovil, and is fitted with a 36 H.P. high-speed engine made by that firm. A larger locomotive—70 B.H.P.—built for a quarry where facilities for the care and charging of accumulators do not exist was provided with a petrol starting engine. It is, also, fitted with Westinghouse brakes. Both these examples are for the standard 4ft. 8½in. gauge.

In conclusion of this unusually brief record of locomotive work during a whole year we may mention that Stephensons completed another replica of the "Rocket," also for America, making the third which has gone to that country. It is perhaps worth putting on record that Dr. Winter, the builder of the famous "Como" model, completed on November 18th a model of the "Rocket" in silver, which is destined for the Council Dining Club table of the Institution of Mechanical Engineers. It has been made to Stephenson's drawings, and although no more than ¾in. to the foot, is faithful in all its dimensions. The construction of it has called for real engineering and, curiously enough, has thrown some light upon the methods of the original builders. As an example of accurate locomotive model making it is without a peer.

Some Bridges of 1931.

THE actual closing of the two arms of the Sydney Harbour Bridge was effected in August, 1930, and a view of it taken just before the closing was complete was given in one of our Supplements last year. The closure, of course, by no means completed the erection of the structure, which was continued during 1931. There is some talk of the Prince of Wales being asked to open the bridge early this year, but of that rumour we have, as yet, received no official confirmation. This huge bridge, we may remind our readers, is one of the two by far the longest single-span arch bridges in the world, the length of the span being 1650ft., and the rise of the arch being 350ft. It gives a clear headway for shipping of 176ft. 6in., and it contains some 37,000 tons of metal. It provides a roadway, 56ft. wide, and two footways, 10ft. wide, and width enough for four lines of electric railways. The abutments measure 224ft. wide by 161ft. long.

Two bridges of an exceptional character were put in service during the autumn, within a few days of one another. Both of them are designed to increase the transit facilities of the City of New York and the surrounding districts, the one being the George Washington Bridge across the Hudson River—formerly called the Hudson River Bridge—and the other the Kill van Kull Bridge, connecting Bayonne with Staten Island. Both of these structures, which are illustrated in one of our Supplements, have already been described at some length in our columns, but they are both so noteworthy that they call for special record in the present instance as being outstanding events of the year 1931.

The George Washington Bridge is of the suspension type, and it has the very considerable span of 3500ft.—being thus by far the largest single-span bridge in the world—with its roadway 250ft. above the River, so that the largest ocean-going vessels can pass under it. To secure these dimensions it was necessary to make the supporting towers at each end as much as 635ft. high. The suspending cables are four in number, arranged in two pairs, 106ft. apart, the two cables in each pair being 9ft. apart from centre to centre. Each cable is 36in. in diameter, and each contains 26,474 steel wires, each 0·196in. in diameter. These wires are divided into sixty-one groups of strands, each made up of 434 wires, over 28,370 tons being used altogether. The special methods employed for "spinning" the wires and compacting the cables were of great interest, and were fully described in our discussions of the various Progress Reports. As at present constructed, the bridge has only one floor, but its calculated capacity is the passage of 30,000,000 vehicles annually. Later, when a second floor is added below that at present in place, that capacity will be doubled.

The Kill van Kull Bridge is a structure of an entirely different type, being a single-span arch. It is of a somewhat similar type to the Sydney Harbour bridge, and actually the distance between the centres of the end pins of its main span is 2ft. longer than that of the Australian structure, being 1652ft., as against 1650ft. On each side of the main span there are steel plate girder span approaches, the total length of the bridge, including its approaches, being well over 1½ miles. The main arch is composed of two arch trusses spaced 74ft. from centre to centre, with a rise of 274ft. from the centre of the bearing to the crown of the lower chord. Each truss has a depth of 37ft. 6in. at the crown and the depth increases slightly towards the abutments, the panel curve of each chord being a true parabola. At the crown of each arch, the upper chord reaches a height of 327ft. above water. There is a clearance of 150ft. above mean high water at the centre of the main span, under extreme conditions of full load and lowest temperature. The main arch is of the two hinge type, and special interest attached to its erection, in view of the fact that it was necessary, in order not to obstruct the waterway, to make the junction between the arms built out from the two abutments, at a point some considerable distance—248ft., in fact—from the crown of the arch, there being fourteen panels on the one side and twenty-six panels on the other. The methods of erection employed were described and illustrated in our issue of June 19th last.

Another bridge to be opened during the year was that over the Nile at Jinga in Uganda. It consists of a spandril braced arch, 260ft. 2in. long, with an approach span, 100ft. long, at each end. A railway is carried on a top deck over the arch, while a 20ft. roadway, with a footway on each side of it, is suspended from the arch. The railway lines are 69ft., and the roadway 35ft. above flood level. The present railway has a gauge of 1 m., but the bridge is wide enough for a 3ft. 6in. gauge line, should it be necessary in future to widen the gauge. The bridge is interesting, among other things, because it is the only structure spanning the River between its source and Kosti, about 1300 miles further downstream.

Still another bridge to be opened during the year was that over the River Esk at Montrose. It is a reinforced structure of the cantilever type, having a centre span of 216ft. and a shore span at each side, each 108ft. long. To provide foundations for the piers on which to support the cantilevers, steel cylinders, each 22ft. 6in. in diameter, were sunk into the river bed. The material inside the cylinders was removed by open dredging, water jets being operated under the cutting edges by divers. When these cylinders were sunk, however, it was discovered by testing that they would not provide a sufficiently firm foundation, and accordingly thirty-two concrete piles, 14in. square, were driven down within each cylinder. Some of these piles were 61ft. long, and some as much as 66ft. long. The driving of them caused each cylinder to rise about 3in., while the soil inside rose 4ft. The soil was cleared away by divers, a seal of concrete was deposited, and the water pumped out from the cylinders. Mass concrete was then deposited inside them up to the river bed level, and, on the mass, hollow piers were built up to some little height above high water level. The steel cylinders which had been built up in sections bolted together, were then flooded, and having been unbolted at river bed level, were then removed. The bridge forms an exceedingly interesting example of reinforced concrete design and erection.

Just before the end of the year an important bridge was formally put into service in India, the opening ceremony being carried out by the Viceroy. It was the Willingdon Bridge which spans the River Hooghly at Bally to the northward of Calcutta. The structure comprises nine steel spans, seven of which are over water, and one on each side over land. The river spans are each 350ft. in length and the two land spans each 80ft. There will be an overhead clearance of 29ft. from the highest known flood level to the under side of the river spans. The seven river piers were formed by sinking double octagonal steel caissons, each of which measures 70ft. long by 37ft. wide. These caissons were built on shore and floated to their destined positions and then sunk. The material on which they rested was then dredged out and the caissons were sunk to an average depth of well over 100ft. in the river bed. The steel work of the caissons was, as the sinking proceeded, carried upwards by adding fresh sections, and when the final positions were reached the tops of the caissons had been taken well above water level. The piers were then built up on the caissons. The river spans, each of which weighs some 2400 tons, were built on staging and floated into the desired positions for hoisting. The floating and hoisting were carried out successfully, in spite of the fact that the River current is, at times, very swift. The bridge has been designed for two lines of railway and two roadways, and to carry a live load of 3 tons per lineal foot.

A NEW lock entrance to the Kidderpore Docks, 80ft. in width, to relieve the present lock from overwork, was opened at the end of November. The new lock is 850ft. in length. The depth of the sill is 19ft. below datum, as compared with 17ft. in the case of the other lock of 60ft. width which has been working so long. This extra depth of 2ft. in the new lock will, it is expected, says *Indian Engineering*, be of great assistance when a number of ships have to be passed out on the same tide.

Shipbuilding and Marine Engineering in 1931.

No. I.

WHEN writing our review of the shipbuilding and marine engineering industries a year ago we commented upon the very difficult position which would have to be faced in 1931, owing to the continued lack of new orders and the general world-wide depression in shipping. Unfortunately, our anticipations were justified. The year which has just ended was, for most shipbuilding centres, one of the worst recorded in recent decades, and at the moment there are, unfortunately, few signs of immediate recovery. Efforts have been made to consolidate and strengthen the industry by the elimination of redundant yards, and National Shipbuilders' Security, Ltd., which early last year was constituted by the issue of a million pounds of debenture stock, has, since its inception, purchased and closed no less than seventy building berths, with a total output capacity of about half a million tons.

The amicable relations between employers and employees in the shipbuilding industry and allied trades were continued during the year, despite a disagreement over wages reduction, and there was no stoppage. After several joint conferences, the Shipbuilding Employers' Federation gave notice on September last that, from the beginning of October, the revised scheme of wages would come into operation, although the unions had expressed their disagreement with it. Arrangements were made by the employers to consider any special cases of admitted hardship.

With so little employment in the industry, the stoppage of work on the new Cunarder at Clydebank on December 12th, which affected directly some 3700 workmen, came as a heavy blow. The hope is to be expressed that some early means may be found of financing the ship, so that her building may proceed, with a view to her completion at no distant date.

During 1931 many schemes for the replacement of old tonnage were discussed, but none was found suitable for adoption.

Despite the difficulties we have outlined above, the completion and satisfactory service results of several noteworthy ships stand to the credit of British builders. In the matter of technical progress, too, ground was not lost and new records in fuel economy and machinery efficiency were gained.

In view of the smaller number of ships to be dealt with this year, we have grouped both steamships and motor ships in the one article, the first part of which, herewith, deals more particularly with the ships completed and commissioned, while in a second part we shall chronicle the principal improvements made in propelling and auxiliary machinery.

Some Outputs of 1931.

Although it is not possible within the scope of this short review to give a complete analysis of the launches made and the total power of the machinery constructed, we may make passing reference to one or two of the larger outputs.

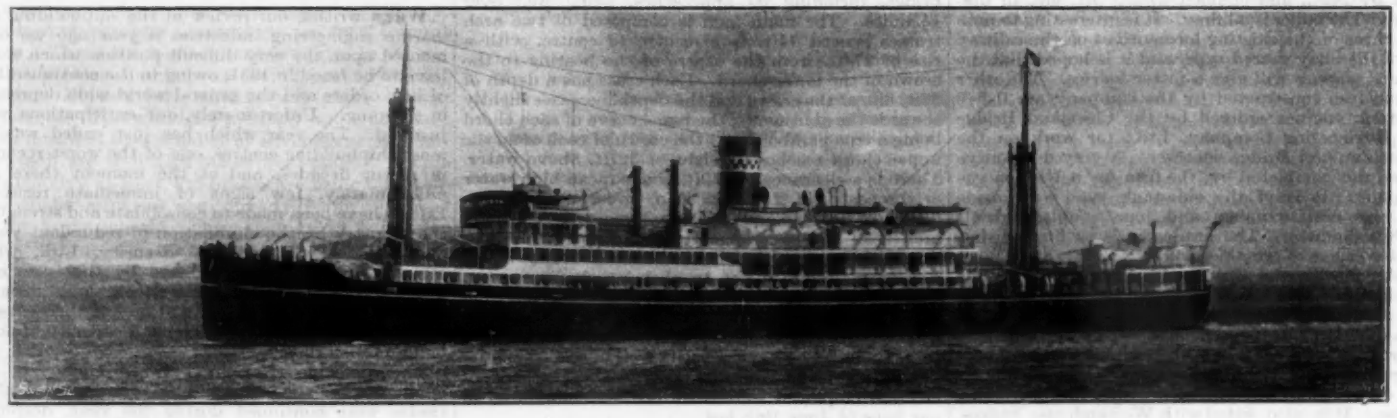
On the Tyne and Wear, Swan, Hunter and Wigham Richardson, Ltd., launched six British merchant steamships, two motor ships, three foreign merchant steamships and three foreign motor ships, totalling, along with two floating docks, an aggregate of 84,244 gross tons; while six sets of machinery, steam and motor, comprised a total of 15,750 I.H.P. The next largest return was that of Harland and Wolff, Ltd., of Belfast, Glasgow, and London, consisting of six ships, both steam and motor, and small craft, totalling 70,298 gross tons, and 45,600 I.H.P. of machinery. At Barrow-in-Furness Vickers-Armstrongs, Ltd., launched three ships, besides the "Monarch of Bermuda," which was built at its Walker Yard at Newcastle, the output totalling 74,046 gross tons and 87,700 S.H.P. All the machinery for these ships, with the exception of the boilers and condensers, was electric, and most of it was supplied by the B.T.H. Company, of Rugby, and the G.E.C., of Witton.

One of the largest outputs on the Clyde was that of Alexander Stephen and Sons, Ltd., of Linthouse, which firm completed four ships aggregating 38,730 gross tons, with 45,000 I.H.P. of machinery. The Parsons Marine Steam Turbine Company, Ltd., of Wallsend-on-Tyne, constructed 82,400 S.H.P. of geared turbines, completed, apart from these, 63,000 I.H.P. of mechanical gearing to be used in association with steam turbines, and cut a further 21,000 S.H.P. of gearing for its various licencees.

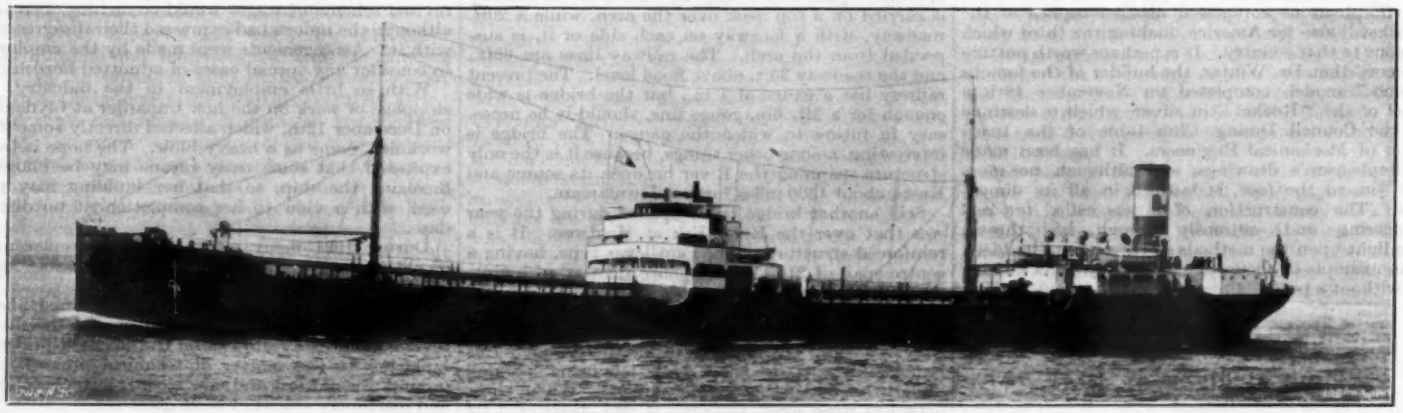
The falling off in motor ship construction was not so large as might have been expected in the circumstances, and according to our records of ships placed in commission, forty-nine motor ships, aggregating about 383,947 gross tons, and 264,500 I.H.P., were completed in the year. Of these ships no fewer than forty were motor-propelled oil tankers. The curve reproduced in Fig. 1 shows the fluctuations of tonnage, machinery power and ships over a period of eleven years, beginning with 1920, in which year only seven motor vessels, aggregating 53,407 gross tons with 31,140 I.H.P. of propelling machinery, were built.

Great Britain again held the leading world position in motor ship construction, being followed by Holland,

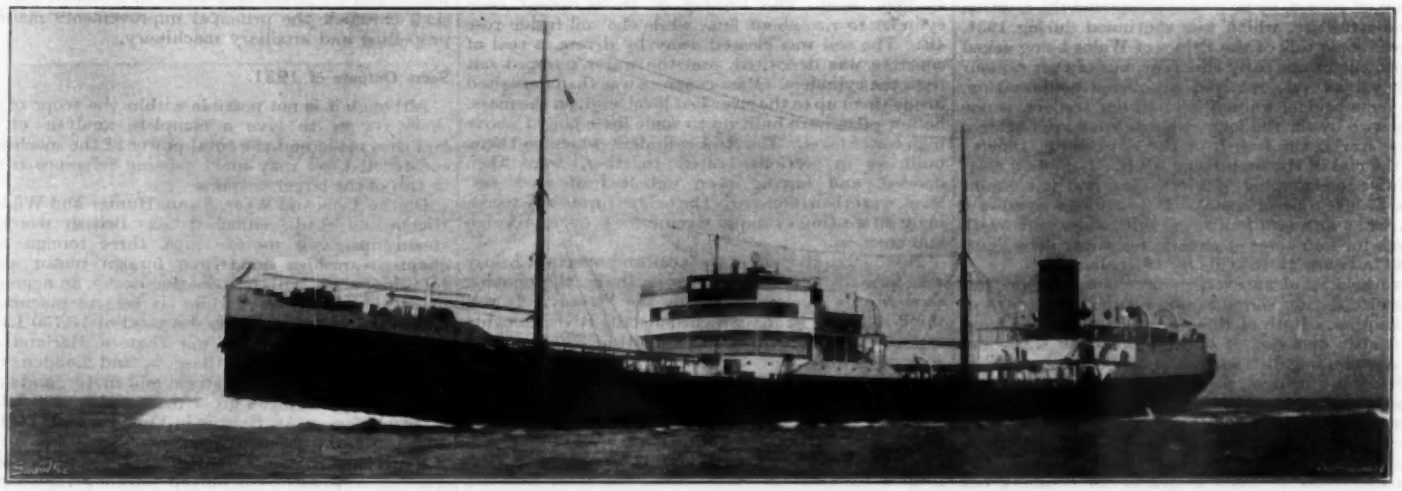
SOME TYPICAL SHIPS OF 1931



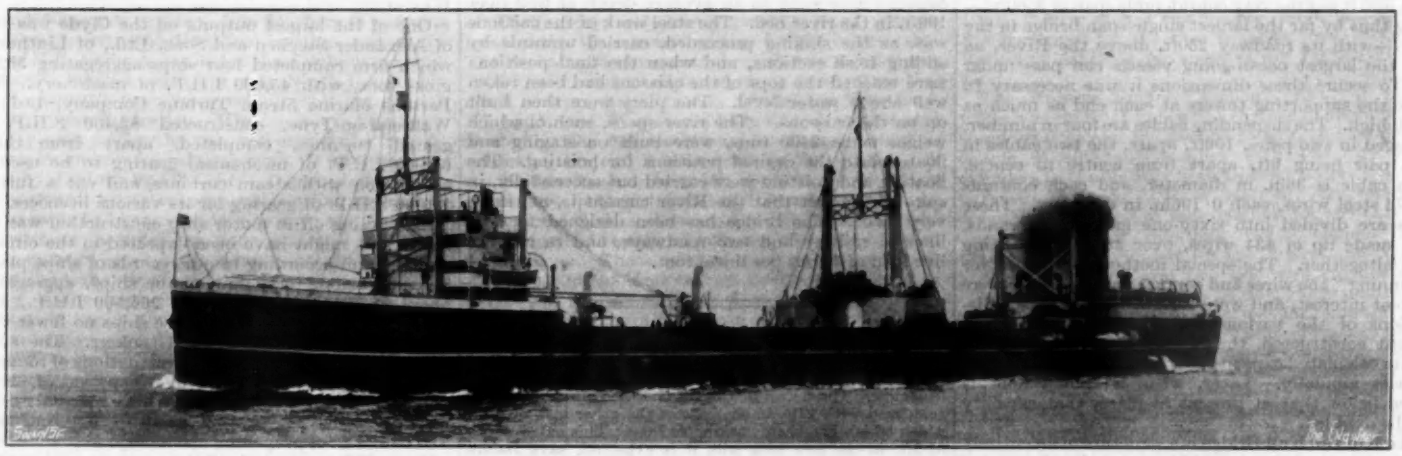
THE MOTOR SHIP "MACDHUI"



THE MOTOR OIL TANKER "ASHMORE"



THE MOTOR OIL TANKER "CAPRELLA"



THE WHALING PARENT SHIP "VESTFOLD"

Germany, and Denmark, each with about 100,000 gross tons. The fall in motor ship construction was not so large as in steamship construction, the world total being about 180 ships, compared with 240 ships for 1930.

Some Large Liners of 1931.

The event of outstanding importance last year was the laying down of the new Cunard express liner No. 534 at the Clydebank Yard of John Brown and Co., Ltd. Up to December 12th, when work upon her ceased, excellent progress had been made with the construction of both hull and propelling machinery, and the contract was well ahead of time. We reproduce in Fig. 2 a prospective view of the completed liner, and in a Supplement give two progress views. The length

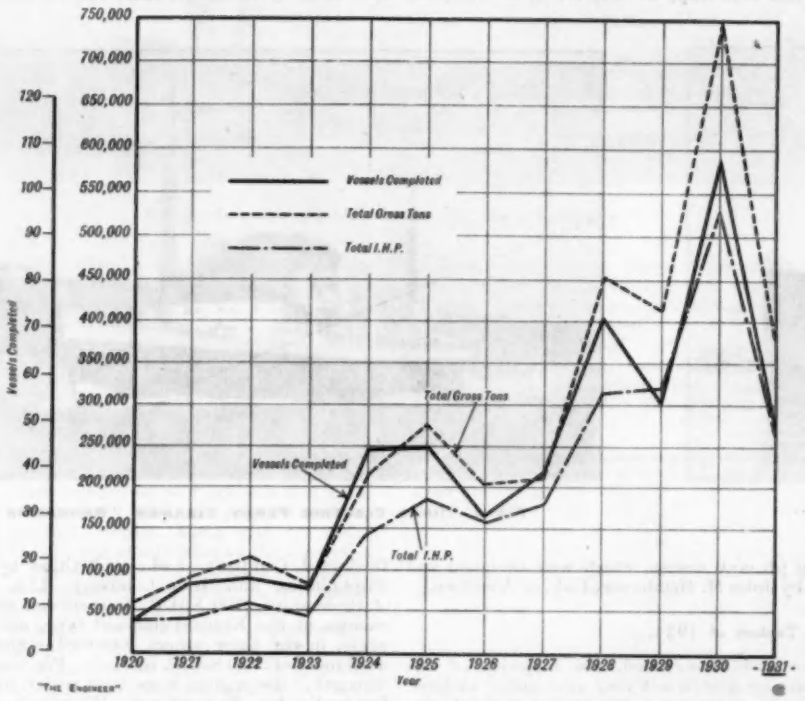


FIG. 1—MOTOR SHIP AND MARINE OIL ENGINE OUTPUTS 1920-1931

of the ship is 1018ft., with a measurement of about 73,000 gross tons, the depth to the boat deck 100ft., and the height to the mast heads 250ft. There are in all eleven decks, the promenade deck being no less than 750ft. in length. The three funnels will be of a characteristic design, the first being 70ft. in height, the two others decreasing in height in such a way that the decks and ventilators will be kept clear of the funnel gases. For important parts of the superstructure high-tensile 40-ton steel is being employed, and to date over 10,000,000 rivets have been closed by hand and by hydraulic and pneumatic riveting machines. A feature of the construction was the delivery by sea from the Darlington Forge Company, Ltd., of the steel stern-frame and propeller brackets and rudder castings, which together totalled over 500 tons.

Special arrangements for the construction of No. 534 were made at Clydebank. The unusual height of the ship encroached on the normal working space, and a bridge has been erected under the bow of the ship in order to allow the delivery of material to the berth. The hull supports have been most carefully designed, and should it be necessary to leave the ship on the stocks longer than was expected, there should be no ill effects, such as sinking, which at one time were referred to by those unfamiliar with ship construction. The views of the partly completed hull reproduced in the Supplement show the derricks and the electrically-operated lifts for the workmen. Up to the stoppage nearly 25,000 tons of material had been built into the hull, or about half her final total weight. No definite particulars with regard to the power of the propelling machinery have yet been made public, but a speed of over 30 knots, with a total maximum power not far short of 200,000 S.H.P. is to be expected. The propelling machinery comprises a quadruple-screw arrangement of the latest type of Parsons single-reduction geared turbines, the overall length of one set of engines being about 55ft. The firm of C. A. Parsons and Co., Ltd., of Heaton, has supplied over a quarter of a million blades for the turbines. The boiler plant will include twenty-seven main and auxiliary boilers, arranged in five boiler-rooms. They are being built at Clydebank to designs supplied by Yarrow & Co., Ltd. The working pressure, judging from that of the auxiliary generator sets, is round about 400 lb. per square inch with 680 deg. to 700 deg. Fah. total temperature. The oil fuel bunkers will number close on fifty. In order to facilitate the launching and docking at Clydebank of the new liner, the Clyde Navigation Trustees undertook to widen and deepen the river Clyde at its junction with the river Cart, while, at a later date, the channel between Clydebank and Greenock will be suitably deepened by dredging.

At Southampton the contractors for the Southern Railway Company's new graving dock recorded good progress, and work on the new berths and goods sheds was well advanced. The new graving dock is to have a length of 1200ft., an entrance width of 135ft. over the buttresses, and a width of 165ft. at the coping level, while the depth of water over the keel blocks will be 48½ft. Ample swinging ground adjacent to the dock entrance has been allowed for.

The largest and most important liner to be completed in 1931 was undoubtedly the Canadian Pacific liner "Empress of Britain," which we illustrate in one of to-day's Supplements. She was fully described in our issues of May 8th, 15th, and 22nd. This liner, which has a length of 760ft. 6in. and a measurement of 42,348 gross tons, is propelled by a quadruple-screw arrangement of Parsons single-reduction geared turbines, with a total designed output of 63,000 S.H.P., corresponding to a normal service speed of about 24 knots. Steam is raised in eight Yarrow and one Johnson water-tube boiler, at a working pressure of 425 lb. per square inch, with a total temperature of 725 deg. Fah. The auxiliary machinery is electrically-operated, there being both turbo and oil engine-driven generator sets.

The "Empress of Britain," we may recall, was designed not to attain a super-speed, but to take full advantage of the geographical conditions on the St. Lawrence route to reduce the duration of the actual sea passage to a point which would compare favourably with the fastest performances of the super-liners on the New York Atlantic run. On her maiden voyage in June last the "Empress of Britain" made the trip between Cherbourg and Father Point in 4 days and 12 hours. That time of passage has since been reduced to 4 days and 9 hours. Experience in service has shown, we understand, that there is a good reserve of machinery power, as yet unused, which will enable the passage to be made in a still shorter time should that be required at some future date. On her twelve-hour endurance trial the liner also set up a new world record for steaming economy by recording a fuel consumption, including the hotel load, of 0·57 lb. of oil per S.H.P. hour for all purposes. That figure has been maintained in service, and a slight improvement on this remarkable performance is expected to be made when final adjustments to the turbine machinery have been carried out. The other "Empress" and "Duchess" class ships of the Canadian Pacific fleet are performing excellent and economical service, as are the coal-burning stoker-fired cargo ships of the same company's "Beaver" class.

In the fleet of the Peninsular and Oriental Steamship Company, Ltd., important additions were made during the year on the company's Australian and Far East routes. The turbo-electric liner "Strathnaver," which was completed by Vickers-Armstrongs, Ltd., at Barrow-in-Furness and entered the company's service in September, is illustrated in to-day's Supplement. She is a 664ft. ship of 22,547 tons, and is propelled by twin-screw B.T.H. impulse type 3000 r.p.m. turbo-alternators, each rated at 10,700 kW which supply three-phase 3000-volt current to two 48-pole, 14,000-S.H.P. motors, running at 125 r.p.m. Steam is generated in four Yarrow high-pressure water-tube boilers, each with a designed rating of 69,000 lb. per hour, which make them the largest yet installed in the British mercantile marine. The working pressure is 400 lb. per square inch, with a blow-off pressure at the safety valves of 425 lb. and a final superheated temperature of 725 deg. Fah. Both on her trials and during her early voyages the "Strathnaver" has shown herself to be a very economical and flexibly speeded ship, while compared with the reciprocating engined steamers of the same fleet, she shows a marked saving in fuel expenditure. The "Strathnaver" will be followed by her sister ship, the "Strathaird," also built at Barrow, early this month.

Two smaller but none the less interesting P. and O-ships are the "Carthage" and "Corfu," con. structed at Alexander Stephen and Son's Linthouse yard for the company's Eastern service. They are 545ft. ships of 14,000 gross tons, and are propelled by a twin-screw arrangement of Parsons single-reduction geared turbines, with a designed output of 15,000 S.H.P., giving a service speed of about 17¾ knots. The boilers are of the Yarrow high-pressure five-drum type, with superheaters and air heaters, and are designed for a working pressure of 400 lb. per square inch with a total temperature of 725 deg. Fah. Both on trial and in service these two ships have more than fulfilled the expectations of the builders and owners.

Another large turbo-electric ship illustrated in to-day's Supplement is the "Monarch of Bermuda," which was built at the Walker Yard of Armstrong-Vickers, Ltd., to the design and under the supervision of Esplen Sons and Swainson, Ltd., for the Furness Withy New York-Bermuda service. Her very special features and the interesting lay-out of her General Electric Company's machinery were fully described in the issues of THE ENGINEER for November 27th and December 4th and 11th. She has a length of 576ft., with a measurement of 20,500 gross tons. Steam is generated in eight Babcock and Wilcox high-pressure water-tube boilers at 400 lb. per square inch with 625 deg. temperature. A feature of the boiler installation is the very low air pressure of only 1½in. water gauge required in the closed stokeholds. It is worthy of note that so successful has been her design and performance that her owners have ordered a sister ship from Vickers-Armstrongs, which will be built at Barrow and will replace the motor liner "Bermuda," destroyed by fire at Belfast while under repair following a previous fire at Hamilton, Bermuda.

Another turbo-electric ship completed by Vickers-Armstrongs, Ltd., at Barrow, is the "Rangatira," built for the Union Steamship Company of New Zealand, Ltd., for ferry and cross-channel service between Lyttelton and Wellington, New Zealand.

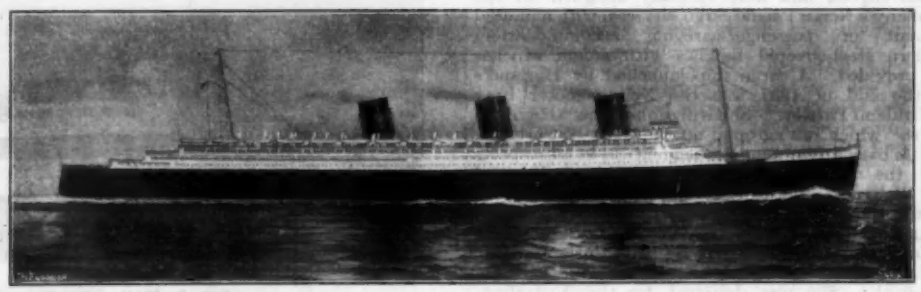


FIG. 2—PROSPECTIVE VIEW OF THE NEW CUNARDER

She has a length of 400ft. and a maximum designed speed of 21½ knots with a normal speed of 17 knots. Her propelling machinery comprises two B.T.H. impulse type turbo-alternator sets each rated at 5120 kW at 3080 r.p.m., the three-phase 3150-volt current being supplied to two 6500 S.H.P., 220 r.p.m. propelling motors on the shafts. Steam is supplied by a battery of six Yarrow boilers of the five-drum front-fired type with superhetaers and air heaters. The generated pressure is 400 lb. per square inch and the total temperature of the steam 725 deg. Fah. In practically all the ships above mentioned the latest type of Weir regenerative condenser is used with a closed feed system.

Among the motor liners completed in 1931 we have chosen for illustration in to-day's Supplement the Union Castle liner "Warwick Castle," and the Pacific

Steam Navigation Company's quadruple-screw liner "Reina del Pacifico," specially designed for South American service. The "Warwick Castle" follows the standard design adopted for the other large motor ships of this fleet, and has a length of 650ft., with a measurement of 20,445 gross tons. She is propelled by two eight-cylinder double-acting four-stroke Harland-B. and W. oil engines with a total designed output of 13,000 S.H.P., corresponding to a sea speed of 15½ knots. The individual scheme of decoration chosen for each of the new Union Castle liners has earned for them a distinctive place in the South African passenger trade. The outstanding feature of the "Reina del Pacifico" is her quadruple-screw arrangement of trunk-piston, airless-injection, supercharged Harland-B. and W. oil engines, which were fully described in THE ENGINEER of April 3rd. These motors give a very low engine-room and a convenient lay-out. On trials 20 knots was attained and in service the ship has been very successful.

Another Harland and Wolff ship of the year, which is approaching completion, is the "Georgic," constructed for the White Star Line at Belfast. She is a sister to the "Britannic," which was one of the most successful ships in that company's Atlantic fleet during the year, carrying a high average of 750 passengers each voyage, with a very economical machinery performance. These ships are 680ft. in length with a gross tonnage of about 28,000, and they are propelled by two ten-cylinder double-acting Harland-B. and W. four-cycle engines with a designed output of 20,000 S.H.P. total.

The "Worcestershire," a 482ft. liner, which was built and engined at the Fairfield Shipbuilding and Engineering Company's Govan yard, was added to the Bibby Line fleet during the year. She is propelled by twin-screw motors of the Fairfield-Sulzer type developing about 7700 S.H.P. total.

Some Noteworthy Cargo Ships.

In Fig. 3 we show the "San Antonio," one of six similar cargo steamers built and engined by Harland and Wolff for the Compagnie Générale Transatlantique. They are all 430ft. ships of 5990 gross tons, propelled by a single 4800 S.H.P. quadruple-expansion balanced steam engine, and were specially designed for the company's North Pacific cargo services, with a limited amount of passenger-carrying accommodation. Modern steel-covered hatches with steam winches are provided. A cargo ship launched by Harland's at the end of 1931 was the Nelson motor liner "Highland Patriot." She will replace the "Highland Hope," which ran aground off the coast of Portugal, a little over a year ago, and is identical in all respects with the other Nelson liners. At Belfast, Harland and Wolff also practically completed the "Achimota" for the Elder Dempster Line.

Another motor ship of unusual interest is the "Macdhui," constructed by Barclay, Curle and Co., Ltd., and engined by John G. Kincaid, Ltd., of Greenock. She was designed for the Australian-New Guinea and Pacific Islands service of Burns Philp and Co., Ltd., of Sydney and London, and is generally similar to the firm's earlier motor ship the "Malabar," but her engines are supercharged on the Büchi pressure-induction principle, the blower being driven by an exhaust gas turbine. The engines have a designed output of 4900 I.H.P., giving the vessel a sea speed of 15 knots. A view of the ship on trial is given on page 18. A new Booth liner, completed by Cammell Laird and Co., Ltd., at Birkenhead is the "Hilary," a 420ft. passenger and cargo ship, with triple-expansion engines working in conjunction with a Bauer-Wach exhaust steam turbine.

At the Neptune Works of Swan, Hunter and Wigham Richardson, Ltd., several passenger and cargo ships were completed for foreign owners. They included the "Djebel Amour," a 336ft. light-draught vessel of 3500 tons deadweight carrying capacity, which was specially designed for the Mediterranean service of the Compagnie de Navigation Mixte, of Marseilles. We illustrate in Fig. 5 the twin-screw passenger 18-knot mail steamship "Prestolonaslednik Petar," which the firm delivered for service along the Dalmatian Coast in the Adriatic.

During the year the British India Steam Navigation Company, Ltd., added two fast twin-screw passenger and cargo liners to its fleet—the "Kenya" and "Karanta"—both of which were built and engined by Alexander Stephen and Son, Ltd., of Linthouse. They are 16-knot ships of 9990 gross tons, and are turbine-driven, Parsons single-reduction geared turbines with cylindrical boilers being installed. A ship of unusual design which was illustrated in our issue of January 30th, 1931, is the "Caldare," built by John Lewis and Son, Ltd., of Aberdeen, for the Australian coal trade. She is noteworthy as being the first ship, we believe, to be equipped with long jib grab cranes, which were designed and supplied by John M. Henderson, Ltd., of Aberdeen.

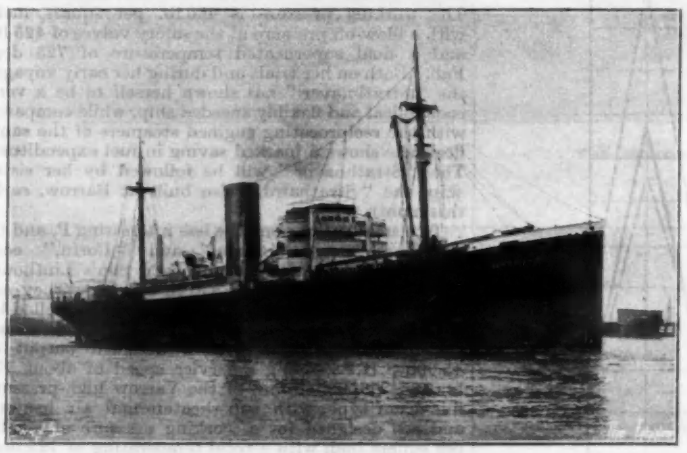


FIG. 3—C.G.T. CARGO STEAMER "SAN ANTONIO"

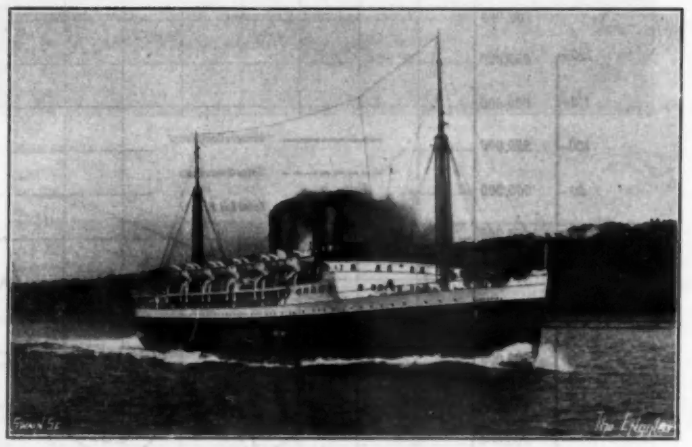


FIG. 4—TURBO-ELECTRIC FERRY STEAMER "RANGATIRA"

Some Oil Tankers of 1931.

As previously mentioned, the majority of the motor ships completed last year were motor tankers. The largest tanker programme was that of the Anglo-Saxon Petroleum Company, Ltd., of which no less than twenty-four vessels were delivered in 1931, leaving three others to be completed early this year. Of the 1931 ships three small vessels—two 3600 and one 4600 tons deadweight capacity—were built by R. and W. Hawthorn, Leslie and Co., Ltd., which firm also constructed two 11,500-ton ships. One of these larger ships, the "Caprella," is illustrated on page 18. Of the further ships of this same type two each were completed by Swan, Hunter and Wigham Richardson, Ltd., Workman, Clark and Co. (1928), Ltd., and Harland and Wolff, Ltd., of Glasgow, while the others were built in Holland, Germany and Italy. The engines, with the exception of one of the Harland and Wolff vessels, which has Harland-B & W single-acting four-cycle oil engines, are of the Werkspoor single-acting, four-cycle type, with the Werkspoor patented system of supercharging, described in our issue of March 21st, 1930. This system utilises, it may be recalled, the bottom of the cylinders, which are closed in and fitted with automatic suction and delivery valves, thereby making them into air compressors. This system was first applied to the engines of the "Megara," described in the article above referred to, which ship has now seen nearly three years of successful service. The success achieved in this pioneer installation induced the owners, on the advice of Mr. C. Zulver, their marine superintendent, to choose this special type of machinery for no less than seventeen of their new tankers, sixteen engines for which were built at the Werkspoor factory in Holland, while others were constructed by R. and W. Hawthorn, Leslie and Co., Ltd., and the North-Eastern Marine Engineering Company, Ltd. These tankers have proved most successful in service, their sea speed of over 12 knots rendering them economical vessels. They are at sea for 300 days per annum. As an example of the trial performance of these ships we may refer to an early vessel of the group, the "Macuba," built by P. Smit, Jnr., of Rotterdam, which, on her trials, attained 13·41 knots, with an output of 4865 S.H.P., the mechanical efficiency being 74 per cent., while a mean indicated pressure of 138 lb. per square inch was recorded.

Another important tanker building programme was that of the British Tanker Company, Ltd., which took delivery of seven tankers, each of about 10,350 tons deadweight carrying capacity. Two were built by Lithgows, Ltd., two by the Greenock Dockyard Company, Ltd., and three by Palmers Shipbuilding and Iron Company, Ltd. In four of these ships 2700 S.H.P., four-stroke, single-screw engines of the Kincaid-Harland type, are installed, while, in the three others, Doxford opposed-piston machinery of 2850 S.H.P. is fitted. For the "British Strength," the engines were built under licence from Doxford's by Richardsons, Westgarth and Co., Ltd., of West Hartlepool. At Dundee the Caledon Shipbuilding and Engineering Company, Ltd., completed three tanker hulls, which were engined in Sweden.

Both on the Tyne and the Clyde several tankers for British and foreign owners were completed. We reproduce a view on page 18 of the oil tanker "Ashmore," built by Sir W. G. Armstrong, Whitworth and Co., Ltd., at the Tyne Iron Shipyard for Scandinavian owners. She is a ship of 9000 tons deadweight carrying capacity, with a speed of 11 knots, an Armstrong-Sulzer oil engine being fitted. At Swan, Hunter's yard a group of four oil tankers of 14,500 tons deadweight carrying capacity, was completed for Norwegian owners. In each of these ships a six-cylinder Wallsend-Sulzer oil engine, built by the Wallsend Shipbuilding and Engineering Company, Ltd., was fitted. Several other ships were built on the Clyde, among which was the oil-electric tanker "Permian," constructed by Scotts Shipbuilding and Engineering Company, Ltd., for the Atlantic Oil Shipping Company, Ltd., to the designs of Mr. Lester M. Goldsmith. This vessel is equipped with B.T.H. oil-electric propulsion, the four 600 kW generators being driven by Carels-Ingersoll-Rand oil engines. Among others two ships built by the Blythswood Shipbuilding Company, Ltd., at Scotstoun, and engined by Kincaids and the North-Eastern Marine Engineering Company, respectively, may be noted. They are the oil tanker "Karabagh," for the Baltic Trading Company, Ltd., and the "Imperial Transport," an 11,500-ton tanker for the Empire

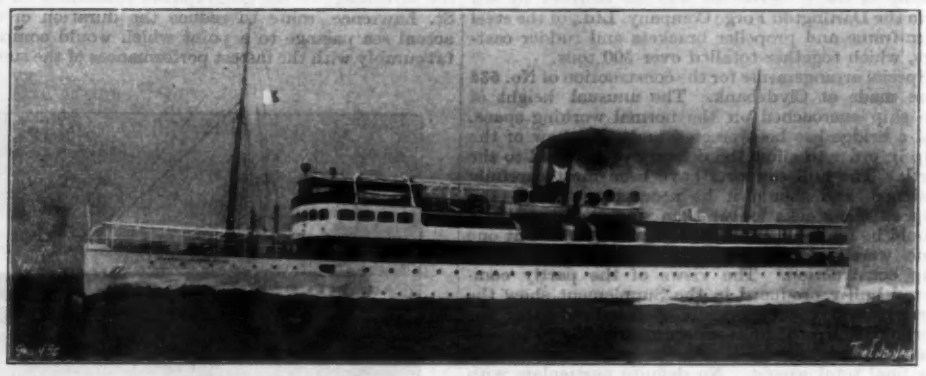


FIG. 5—MAIL STEAMER "PRESTOLONASLEDNIK PETAR"

Transport Company, Ltd. All the oil tankers referred to above are motor tankers, but steam propulsion was chosen for the Burmah Oil Company's "Singu," constructed by Swan, Hunter and Wigham Richardson, Ltd., and engined at the Wallsend Slipway. In this ship the machinery is of the triple-expansion type. Similar machinery was installed in the "Pan Bolivar," built and engined by the same firms for American owners, and in this particular ship the exhaust steam is utilised in a Bauer-Wach exhaust turbine plant.

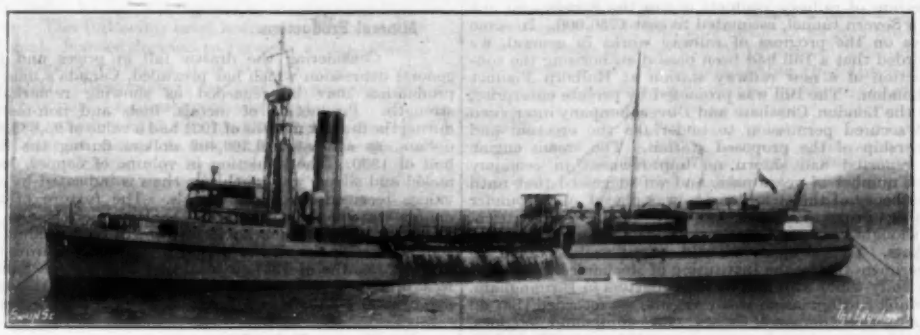


FIG. 6—SUCTION HOPPER DREDGER "PILCOMAYO"

Three Floating Whaling Factories.

Although there was a lull in the whaling industry during the year, pending an investigation into world whaling conditions, three further mother whaling tankers, or floating whale oil factories, were completed in 1931. For a full description of these very specialised and unusual ships, our readers may be referred to a paper read by Mr. Chr. Fred Christensen before the North-East Coast Institution of Engineers and Shipbuilders on January 30th, 1931. On page 18 we illustrate the "Vestfold," which, along with her sister the "Svend Foyn," was constructed at the Haverton Hill Yard of the Furness Shipbuilding Company, Ltd., and was engined by Richardsons, Westgarth and Co., Ltd., of West Hartlepool. Each of these vessels has a length of 550ft. and a deadweight carrying capacity of about 22,600 tons. There are ten oil cargo compartments, which are divided into forty tanks by three longitudinal bulkheads. The cruiser stern is furnished with an oak-sheathed skid-way, which allows the whale carcases to be drawn up on to the deck. The propelling machinery comprises a twin-screw arrangement of quadruple-expansion steam engines, each of which is designed to develop 2600 I.H.P. on normal service, steam being supplied from cylindrical boilers.

Machinery of a similar type constructed by Workman, Clark (1928), Ltd., was installed in the whaling factory ship "Kosmos II.," a repeat of "Kosmos I.," which was built at Belfast. This ship has a length of 580ft. and has a displacement of about 34,000 tons. Like the two other ships above referred to, the "Kosmos II." was constructed under the supervision of Messrs. Arnesen Christensen and Smith, of Newcastle-on-Tyne, for Norwegian owners.

Railway Boats, Coastal and Cross-Channel Ships.

The steamers completed during 1931 for railway companies included the "Princess Margaret," a new 325ft. 20-knot, turbine-propelled cross-Channel steamer for the L.M.S. Larne-Stranraer service, built and engined by Wm. Denny and Bros., Ltd., and the "Isle of Sark," also completed by the same firm for the Southern Railway Company's Channel Islands service. The same builders constructed an interesting type of electrically-propelled motor ship, the "Lochfyne," for the Staffa-Iona and Gourock-Ardrishaig services of David MacBrayne (1928), Ltd. She was fully described in our issue of June 5th, 1931, when we dealt both with her hull construction and her Davey, Paxman-Metropolitan-Vickers propelling machinery. Although full performance particulars are not yet available, we are given to understand that the "Lochfyne" has proved a very successful ship, both on her summer and winter runs. That she has carried with comfort a large number of passengers on occasions when few people would have ventured on a trip in the older vessels seems a good testimony to her sea-going qualities. At Govan the Fairfield Shipbuilding and Engineering Co., Ltd., completed the "Jeanie Deans" for the L.N.E.R. Clyde Coast Service, and also the "St. Seiriol" for the Liverpool, North Wales and Isle of Man Service. At Birkenhead, Cammell Laird and Co., Ltd., launched the "St. Andrew" and "St. David," two new 325ft., 2500 gross ton, twin-screw, cross-Channel steamers for the Fishguard and Rosslare service. They will be propelled by Parsons geared turbines, built at Birkenhead, steam being provided by Babcock and Wilcox boilers. The steamer "Aire" was also completed by Cammell Laird for the London, Midland and Scottish Railway, while work was begun on a new Thames pleasure steamer. At Hull, Earles Shipbuilding and Engineering Company, Ltd., completed the passenger steamer and tender "Sir Richard Grenville," which will be employed for tender work at Plymouth and for short coastal trips. At the Thorne Yard of Richard Dunston, Ltd., near Doncaster, several smaller ships and lighters for harbour and general service were completed. At Scotstoun, Yarrow and Co., Ltd., completed a tug and two lighters for shallow-draught service for the Crown Agents for the Colonies. A special steamer for motor car transport between England and France is the "Autocarrier," built for the Southern Railway Company by David and William Henderson, Ltd. of Partick, Glasgow. Early in the year John I. Thornycroft and Co., Ltd., delivered the "Medina," a motor ship propelled by Gardner engines, which was specially designed for the Southampton-Isle of Wight service. We have also to record the commissioning of the motor ship "Venus" on the Newcastle-Bergen service. She is a 19½ knot liner, making the voyage between the two ports in about 21 hours. She was built by the Elsinore Shipbuilding Company, Ltd., of Denmark, and engined by Burmeister and Wain.

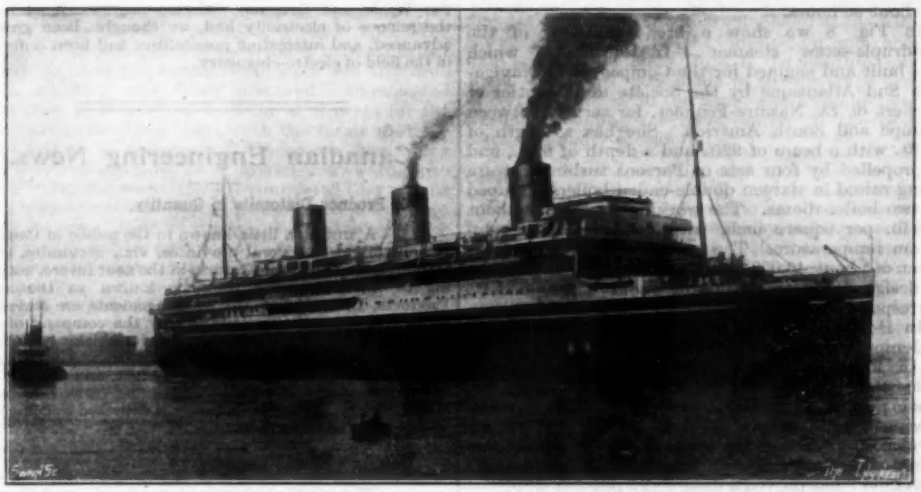


FIG. 8—FRENCH SOUTH AMERICAN LINER "L'ATLANTIQUE"

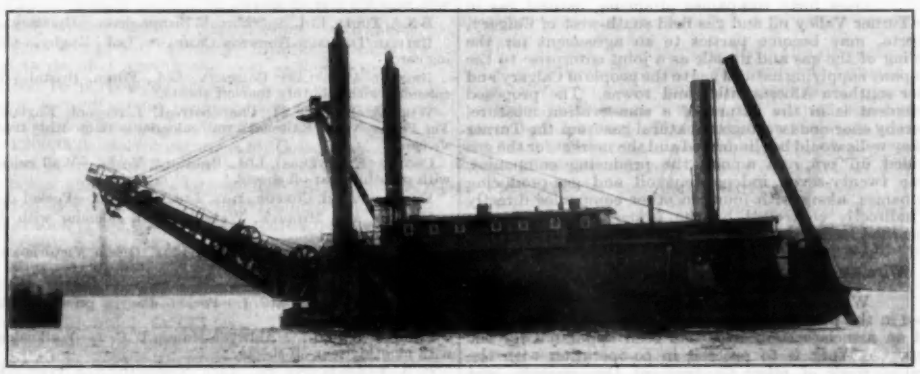


FIG. 7—DIPPER DREDGER "CYCLOPE"

Some Dredgers of 1931.

One of the largest dredgers of 1931 is the "Robert Hughes," designed and built for service in Nigeria by Wm. Simons and Co., Ltd., of Renfrew. She has a twin-screw arrangement of 3000 I.H.P. total triple-expansion steam engines and three cylindrical boilers burning coal under forced draught, and her gross tonnage is 2880. Her dredging outfit consists of a set of triple-expansion enclosed engines with forced lubrication, which are fitted between two cast steel dredging pumps, each of which is of ample capacity for full duty, and arranged so that one pump may be overhauled while the other is at work. Three separate and distinct forms of outboard dredging equipment are provided, namely:—(1) A plain suction nozzle, universally jointed at the lower end of the suction pipe, for general bar service; (2) a suction frame fitted with a powerful rotary cutter driven through machine-cut steel gearing by a compound condensing engine fitted on the same frame; (3) a drag suction nozzle of the flexible type arranged so that the vessel may take her load when steaming freely in a fairly rough seaway. She has a designed capacity for dredging and discharging 2500 tons of spoil per hour into her own hopper or into barges moored alongside, and in addition to main hopper valves of the cylindrical type, which discharge through the bottom, the hopper is provided with a system of pipes and doors so that the load may be discharged through a pipe line for reclamation purposes if so desired. The accommodation is specially equipped for tropical service, and the dredger embraces several improvements in details suggested by the working of similar vessels built by Simons and Co. for Lagos.

A smaller dredger was constructed for the Tees Conservancy Commissioners by the same builders. It is of the barge loading bucket pattern with a measurement of 580 gross tons, and is equipped with 750 I.H.P. engines, which serve either for propulsion or for driving the dredging machinery. The spoil can be discharged into barges on either side at the rate of 1000 tons per hour, the dredging depth being 50ft. below water level.

At the Renfrew establishment of Lobnitz and Co., Ltd., the largest dredger of the year was the suction hopper dredger "Pilcomayo," illustrated in Fig. 6 and built for the Chilian Government. Her length is 296ft., her beam 48ft., and her depth 21ft. The propelling machinery is designed for 10 knots with a fully loaded vessel. The hoppers have a total capacity of 1800 tons and they can be filled with spoil under one hour by two pumps with 20in. connections. The dredging depth is 42ft. The machinery has been so designed that by means of a system of hydraulically operated clutches controlled from a central house it can be used for discharging ashore in a pipe line or into barges alongside. If hard clayey ground is met with a powerful rotary cutter can be attached to the end of the suction pipe and the dredger manœuvred and walked forward by two long spuds or legs. The four engines total 2500 I.H.P. and they can be clutched in to drive either the pump or the propellers. Messrs. Lobnitz also completed suction dredging machinery for the "San Cristobal" and built several small craft for harbour and dock service.

The dipper dredger "Cyclope," built by R. and W.

Hawthorn, Leslie and Co., Ltd., for the Port of Havre Authority, is a somewhat unusual vessel. Her machinery was designed and supplied to the hull builders by the Bucyrus Erie Company, of Milwaukee. A general view of her is given in Fig. 7 on the preceding page. The dipper is equipped with steel teeth and is designed to lift about 10 tons of clay at a time from the river bed. All the machinery controls are conveniently operated from the bridge. There are five steam engines which control the various motions of the legs and the dipper arm.

Some Large Liners Built Abroad.

During the year some noteworthy liners were built and commissioned abroad. Work was well advanced on the new 1018ft., 60,000-ton, quadruple-screw liner which is being constructed at the Penhöet Yard, St. Nazaire, for the French Line. She will be electrically-propelled, the machinery being constructed in France, and the power has been given as about 160,000 S.H.P. total. In Italy, the new N.G.I. liner "Rex" was launched at Genoa, while at Trieste the "Conte de Savoia," for the Lloyd Sabaudo Line, also took the water, and both vessels are now approaching completion. The last-named ship is noteworthy as being the first large passenger liner to be automatically stabilised on the Sperry gyroscopic principle. Both these new Italian liners are 40,000 to 50,000 gross ton ships, turbine-propelled by four shafts. Another quadruple-screw liner built at Trieste for the Trieste-Alexandria service of the Lloyd Triestino Line is the "Victoria," which is illustrated in to-day's Supplement. She has a length of 532ft., a measurement of 13,500 gross tons, and her Sulzer engines are designed for a total output of 17,000 S.H.P., corresponding to a service speed of 21 knots, She is reported to have attained a speed of 23½ knots on the official trials, making her the world's fastest large motor ship. On this ship the journey from London to Alexandra can be completed in about 90 hours.

In Fig. 8 we show a broadside view of the quadruple-screw steamer "L'Atlantique," which was built and engined for the Compagnie de Navigation Sud Atlantique by the Société des Chantier et Ateliers de St. Nazaire-Penhöet, for service between Europe and South America. She has a length of 733ft. with a beam of 92ft. and a depth of 67ft., and is propelled by four sets of Parsons turbines, steam being raised in sixteen double-ended boilers, grouped in two boiler-rooms. The working pressure is about 224 lb. per square inch, with 644 deg. Fah. total steam temperature. The new liner has a displacement of about 40,000 gross tons, and her machinery is designed for an output of about 45,000 S.H.P., corresponding to a speed of about 21 knots.

In Holland an outstanding ship of the year is the "Dempo," a 574ft., 17,000-ton motor liner, built by the Fijenoord Company, to the designs of the Royal "de Schelde" Shipbuilding Company, of Flushing. She is propelled by twin-screw Schelde-Sulzer engines, having a total output of about 14,000 S.H.P., the service speed being 18½ knots. On the Rotterdam Lloyd Company's Dutch East Indies service the "Dempo" has proved a deservedly popular ship.

In America two noteworthy turbo-electric liners of the year are the "President Hoover" and "President Coolidge," which were constructed by the Newport News Shipbuilding and Dry Dock Company, and engined by the General Electric Company, of Schenectady. They have a length of 653ft., and the two propelling motors have each a designed output of 13,250 S.H.P. Steam is supplied by Babcock and Wilcox boilers at 275 lb. per square inch, with 200 deg. of superheat. On the trial runs the guaranteed speed of 20·5 knots was exceeded. Towards the end of the year, the twin-screw 30,000-ton liner "Manhattan," built for the United States Lines at the New York Shipbuilding Company's Camden Yard, New Jersey, was launched. She is a 705ft. ship, with a designed service speed of about 20 knots. A sister ship will be launched during the next few months.

(To be continued.)

SIXTY YEARS AGO.

As had been our custom in the past and as is still our custom to-day, we reviewed in our first issue in 1872—dated January 5th—the progress of engineering during the preceding twelve months. The Mont Cenis tunnel had been opened and the construction of a second tunnel—the St. Gothard—was being discussed. The "comparative success" of the Suez Canal had inspired thoughts of similar works elsewhere. The United States Government had spent considerable sums on exploration in Panama, and it was reported that a possible route for a ship canal had recently been found. Another projected enterprise consisted of the provision of a continuous navigation route from the Mississippi to the Atlantic by the construction of a canal round Niagara. Yet another proposed canal was one to connect the Black Sea with the Caspian. Among other schemes afoot on the Continent was one for the improvement of Calais and Boulogne harbours, with a view to providing facilities for the operation of train ferries. French civil engineers were, however, for the moment, chiefly occupied in repairing the damage done during the Franco-Prussian War and the ensuing period known as the Commune. It was said that among other works engaging or awaiting attention was the reconstruction of sixty bridges in the neighbourhood of Paris. In Great Britain civil engineers were chiefly concerned for the time being with problems of sanitation, but more had been done in inquiring into existing evils than in executing works designed to overcome them. Of bridges we had little to record, except to note the progress of the work on the Albert Bridge over the Thames at Chelsea, and to comment upon the urgent need for the removal of all the old timber structures which still spanned the river and their replacement by new, more convenient and more secure bridges. We noted various schemes for the construction of railway viaducts across the Severn and one for a Severn tunnel, estimated to cost £750,000. In some notes on the progress of railway works in general, we recorded that a Bill had been passed authorising the construction of a new railway station at Holborn Viaduct in London. The Bill was promoted by private enterprise, but the London, Chatham and Dover Company interposed and secured permission to undertake the erection and ownership of the proposed station. The steam engine we reported had shown no improvement in economy for a number of years past, and we suggested that until the theory of the steam engine was placed on a sounder footing progress would be very slow. Information, we thought, was particularly wanted on the value of steam jackets. That subject, we held, might well be taken up experimentally by the Institution of Mechanical Engineers—a body which still had its headquarters in Birmingham. Turning to the marine steam engine, we recorded that an unparalleled demand existed for compound engines, and that every maker was overwhelmed with orders. Nothing remarkable had been done in the locomotive world during the year, for Mr. Stirling's great engine, with drivers 8ft. 1in. in diameter, could not properly be said to have originated in 1871. After much uphill work overcoming prejudice, Mr. Fairlie had achieved success with his double-bogie engine, of which several examples were being built in this country and the United States. Great strides had been made in the use of steam on common roads, largely as a result of the work of Mr. Thomson, of Edinburgh. Rubber tires had been tried on a road steamer—the "Ravee"—on a trip from Ipswich to Edinburgh, and back, but two of them had been disabled. As each cost about £50, the cost worked out at about 2s. 2½d. per mile for tires alone. With the invention of the Wilde and Gramme "electro-magnetic machines," the science of electricity had, we thought, been greatly advanced, and interesting possibilities had been unfolded in the field of electro-chemistry.

Canadian Engineering News.

To Produce Diatomite in Quantity.

A MINERAL little known to the public in Canada, though found in several provinces, viz., diatomite, is to be mined in quantity in Ontario in the near future, according to the plans of a company known as Diatomite Products, Ltd., of Toronto. Arrangements are stated to be complete for the exploitation by the company of the diatomaceous mud occurring in certain lake beds near Huntsville in the Muskoka district of Ontario. The mud will be pumped out by a suction dredger, and calcined for the recovery of diatomite. A calcining furnace is being constructed, and the new industry is expected to come into operation at an early date.

Ontario's Mining Industry.

The mining industry of the province of Ontario is the most prosperous of the basic industries at the present time. The mines, smelters and quarries produced mineral products to the value of 50,997,740 dollars during the first six months of 1931. While that figure showed a decrease of 12·4 per cent. as compared with the value of production in the first six months of 1930, the decrease is largely accounted for by the low prices prevailing for several of the metals, the gold mining industry having shown a record in output. Gold alone accounted for 20,608,195 dollars against 17,337,123 dollars for the similar period of last year.

To Conserve Natural Gas.

Over forty companies producing natural gas in the Turner Valley oil and gas field south-west of Calgary, Alberta, may become parties to an agreement for the pooling of the gas and its sale as a joint enterprise to the company supplying natural gas to the people of Calgary and other southern Alberta cities and towns. The proposed agreement is in the nature of a conservation measure, whereby enormous wastage of natural gas from the Turner Valley wells would be eliminated and the market for the gas divided up *pro rata* among the producing companies. Some twenty-seven independent oil and gas-producing companies, along with fourteen other companies directly or indirectly controlled by the Imperial Oil, Ltd., are concerned in the proposed arrangement.

Wireless Research.

Wireless research has been assigned a definite place in the plans of the National Research Laboratories, and an associate committee has been appointed for the purpose. Work is to proceed in co-operation with the wireless work of other Government Departments, and arrangements are being made whereby the wireless standardisation laboratories of the Department of Marine shall be placed in the new National Research Laboratories building in Ottawa. Numerous problems have been brought to the attention of the Research Council. One of the most important is that of assuring that Canada shall have at all times a highly accurate primary standard of wireless frequency.

St. Lawrence Situation.

Expression is being given in many quarters to the feeling that, while baulked in years of prosperity by the cost of St. Lawrence deep waterway construction the present depression may force the Government into proceeding with it as an employment project in 1932. If conditions similar to those which now exist are faced next summer, the St. Lawrence plan may be taken into consideration as a medium for furnishing work. A proposal to begin work on the waterway was given some thought early in the past year, but was rejected as unnecessary for the present. Reluctance to proceed with the work is said to be based chiefly upon the fact that the power which would be developed is not needed at present in Canada, and will not be for some years. Either it must be wasted in the meantime or exported to the United States.

Mineral Production.

Considering the drastic fall in prices and the general depression which has prevailed, Canada's mineral production may be regarded as showing remarkable strength. Production of metals, fuels and non-metals during the first six months of 1931 had a value of 95,689,288 dollars, as against 116,360,409 dollars during the first half of 1930. The reduction in volume of copper, lead, nickel and silver, was much less than is indicated by the values received for those metals. The feature of the metals statement compiled by the Dominion Bureau of Statistics was the remarkable increase in gold production compared with the similar period a year ago. During the first six months of 1931, a total of 1,273,303 fine ounces was produced, compared with 976,235 oz. in the first half of 1930.

Big Western Hydro Scheme.

The province of Saskatchewan's projected hydro-electric power scheme, involving the development of the Saskatchewan River as the source of supply at a point about 45 miles east of Prince Albert, and erection of transmission lines to the four largest cities in the province, will, it is estimated, cost initially 15,000,000 dollars and an additional 3,000,000 dollars a few years later. It is, at present, proposed to construct a dam to give a head of 125ft. on the turbines, which would supply 43,200 H.P. of continuous power throughout the year, or at a 50 per cent. load factor would provide 86,000 H.P. of saleable power. The initial constructional plans include the installation of two generating units and the running of approximately 400 miles of high-tension transmission lines.

Water Supply Project.

The City of Toronto recently gave an order to the Foundation Company of Canada for a submerged fresh water intake on Lake Ontario. The work will necessitate the sinking of a compressed air caisson 3300ft. from the shore to meet a tunnel which has been driven that far. A steel pipe line encased in concrete is to be laid in an excavated trench from the shaft 4250ft. farther out into the lake. The depth of water is approximately 50ft. Each section of pipe is 100ft. long and weighs 250 tons. Actual operations will be started early in the spring and the work is to be completed by the autumn of 1933.

Alberta Tar Sands.

The plant of the International Bitumen Company, near McMurray, Alberta, which came into commercial operation about the middle of August, is now producing bitumen from the tar sand deposits at the rate of twenty barrels per day, and, according to R. C. Fitzsimmons, president and field manager of the firm, changes to be made in the dehydrating plant this winter will bring production next summer close to 200 barrels per day. The present plant is the result of five years of experimental work, and a total of 150,000 dollars has already been spent in preparing the ground and setting up the plant, which is valued at more than 25,000 dollars.

CALENDARS, DIARIES, &c.

AVONSIDE ENGINE COMPANY, Ltd., Bristol.—Wall calendar, with monthly tear-off sheets.

BABCOCK AND WILCOX, Ltd., Babcock House, E.C. 4.—Greeting card.

BRITISH JEFFREY-DIAMOND, Ltd., Wakefield.—Wall calendars with monthly tear-off sheets.

B.S.A. TOOLS, Ltd., Sparkbrook, Birmingham.—Greeting card.

BRITISH THOMSON-HOUSTON COMPANY, Ltd., Rugby.—Greeting card.

BRISTOL AEROPLANE COMPANY, Ltd., Filton, Bristol.—Wall calendar with monthly tear-off sheets.

WILLIAM BRYDE, 24, Chapel-street, Liverpool, England.—The Pennsylvania Railroad's wall calendar with monthly tear-off sheets.

CROFTS (ENGINEERS), Ltd., Bradford, Yorks.—Wall calendar with monthly tear-off sheets.

ENGLISH STEEL CORPORATION, Ltd., Sheffield.—Pocket diary.

HILDICK AND HILDICK, Walsall.—Wall calendar with daily tear-off slips.

KINGS PATENT AGENCY, Ltd., 146A, Queen Victoria-street, E.C. 4.—Desk diary.

NATIONAL UNION OF COMMERCIAL TRAVELLERS, 24, Thavies' inn, Holborn-circus, E.C. 1.—Pocket diary; price 1s. 8d. to non-members.

PALMER TYRE, Ltd., Aldwych House, W.C. 2.—Wall calendar with monthly tear-off sheets.

C. A. PARSONS AND CO., Ltd., Newcastle-upon-Tyne.—Wall calendar with monthly tear-off sheets.

PECKETT AND SONS, Ltd., Bristol, England.—Wall calendar with monthly tear-off sheets.

HENRY SIMON, Ltd., Cheadle Heath, Stockport.—Desk calendar with daily tear-off slips.

STANTON IRONWORKS COMPANY, Ltd., near Nottingham.—Pocket diary.

S. S. STOTT AND CO., Laneside Foundry, Haslingden.—Wall calendar with monthly tear-off sheets.

R. WHITE AND SONS, Widnes, Lancs.—Pocket diary.

WILLIAMS, LEA AND CO., Ltd., Clifton House, Worship-street, E.C. 2.—Wall calendar with monthly tear-off sheets.

EDWARD WOOD AND CO., Ltd., Manchester.—Wall calendar with monthly tear-off sheets.

Sanitary Engineering in 1931.

Introduction.

A VERY large amount of work in connection with sewerage and sewage disposal was in course of execution in different parts of the country. Reports as to progress made during the year by some of the more important undertakings are given in the various separate paragraphs which follow, but it is quite impossible to make reference to everything that was done. The following brief notes may, however, be of interest. Exeter decided to proceed with a new sewerage scheme, which is, it is said, to cost upwards of £145,641. Birkenhead revived a proposal, which was postponed a number of years ago, for a drainage scheme which would involve the driving of a tunnel. The cost is stated to be in the neighbourhood of £200,000. Gillingham was, and is still, engaged in the construction of 25 miles of sewers and storm water drains varying in diameter from 9in. to 39in. in the Rainham and Lower Gillingham districts, as well as of low-level pumping stations. The estimated cost of the whole undertaking is £200,000. Clacton was busy on the construction of a main outfall sewer, a pumping station, and a sea outfall. Paisley has under consideration a new sewage disposal scheme which is estimated to cost £400,000. Swansea proposes to spend the large sum of over £2,000,000 on electricity and main drainage schemes. A six-mile-long main trunk sewer, a contract for the construction of which was entered into during the year, and which will alone cost over £700,000, forms part of the undertaking. The Ayr County Council received from Mr. J. B. Brodie, of Glasgow, a report regarding a drainage scheme for towns in and near the valley of the River Garnock, the estimated cost being £161,000. Skegness deliberated on proposals for sewage disposal—by land treatment and, alternatively, discharge into the sea—the estimated costs being some £80,000 and £70,000 respectively. New sewage works at Workingham necessitated the construction of 15 miles of sewers, the installation of electrically-driven and oil engine-driven pumps, treatment tanks, percolating filters, &c. A Ministry of Health inquiry was held regarding the application of the Norfolk County Council to borrow £93,740 for sewerage works in Norwich. What is known as the Middlesex Sewerage Scheme, which is to deal with an area of some 120,700 acres, was proceeded with. The scheme, which is said to involve an eventual expenditure of between £5,000,000 and £6,000,000, will serve a population of over 1,800,000 persons. Southwark decided to carry out a main drainage scheme at a cost of £42,000. The Caterham and Warlingham Urban District Council was, and still is, engaged on the construction of 14 miles of sewers, at an estimated cost of £52,000. Large extensions of its sewerage network were carried out by the Epsom Rural District Council. A Ministry of Health inquiry was held into the application of Leek to borrow £86,000 for sewerage and sewage disposal works. New Sewage disposal works at South Benfleet, which cost approximately £45,000, were formally put into operation. For the Borough of Wrexham the construction of a main outfall sewer, including two elevated aqueduct crossings, and of sewage disposal works was proceeded with. The work, which is not yet completed, will cost some £37,500. Caister-on-Sea was occupied in the carrying out of a drainage scheme, including the construction of three pumping stations and an outfall to discharge the effluent into the River Bure. When completed the works will have cost some £35,000.

The foregoing does not pretend to be in any way a complete list of all the works that were in progress, and of all the schemes in hand during the year, but it gives some idea of their diversity in scope and magnitude. In addition, there were a very large number of places which had sewerage and sewage disposal works under consideration. Upwards of between sixty and seventy different towns and districts decided during the year either to apply for sanction to borrow, or actually received sanction to borrow, sums of money ranging from £25,000 onwards. The expenditure involved runs, in some cases, to over £200,000—as, for instance, for Bolton and Egham, the first of which will spend just above and the other just below that figure. Other large outlays are to be incurred by Farnham (£154,500), Guildford (£145,000), Kilmarnock (£190,000), Oldbury (£104,000), Paignton (£243,000), Sale (£237,524), Stroud (£150,000), and Worthing (£135,450). Furthermore, there are innumerable places in which the expenditure, though in many cases it will nearly reach that figure, will not amount to as much as £25,000. The aggregate total involved must be very large indeed. In fact, for districts within 25 miles of Charing Cross, and outside the Metropolitan area, the Ministry of Health has, during the past three years, given sanction for loans for 306 schemes for sewerage and sewage disposal, the aggregate estimated cost being upwards of £3,700,000.

Bangor (County Down).

In 1929 the Bangor Corporation obtained an Act in the Parliament of Northern Ireland for the construction of a new main intercepting sewer, storage tanks, pumping station, rising main, and new outfall at Ballymacormick Point, and work was in progress during the past year on the construction of the intercepting sewer and storage tanks, the value of that part of the work amounting to about £50,000. Since the Act was obtained, negotiations have taken place between the Corporation and neighbouring local authorities and landowners, and the Corporation is depositing a Bill during this session with the Parliament of Northern Ireland for an alteration in the point of outfall. The new point suggested is at Briggs Rocks, which is considerably further to the east than the site originally intended, and will enable the sewage of the small town of Groomsport to be drained into the scheme. It is hoped that the amending Bill will be unopposed, and if it becomes an Act the completion of the scheme will be proceeded with during the present year. It is anticipated that the further expenditure involved will amount to about £40,000.

Bexhill.

The extended sea outfall at Bexhill was completed in June. The works consisted of a new egg-shape 5ft. 2in. by 3ft. 6in. main intercepting sewer, additional storage tanks, and the construction of a new 48in. diameter cast iron sea outfall carried out to a point 1000ft. beyond low-water mark of ordinary spring tides. The sea outfall pipes were laid in a trench of an average depth of 4ft. 6in. in the bed of the sea, and the work was carried out by divers working off two pontoons. After the original contractors for the sea outfall work had failed, the work was successfully completed by L. J. Speight, Ltd., of Imperial House, Kingsway, W.C. 2, under difficult conditions. The total cost of the works amounted to approximately £80,000.

Blackburn.

Since this time last year practically the whole of the open trench work in connection with the Witton to Samlesbury outfall sewer has been completed, only certain manholes and surface replacement still remaining to be done. The greater part of the overhead reinforced concrete work was finished, the part still to be constructed including a 180ft. span arch bridge. Gantries have been erected to a sufficient height to take the actual form-work for the arch soffit, which is now being prepared. Unexpected difficulties in connection with the abutments for the foundations were met with, with the result that the work had to be redesigned. Under one foundation two headings are now being driven downwards into the hillside, and when they are completed they will be filled with concrete so as to form inclined piles. Two attempts were made at driving shafts down for the longest and deepest tunnel work, but they had to be abandoned because wet running sand was encountered. The heading will now be driven for a length of 470 yards without an intermediate shaft. The amount of heading work still to be done is about 200 yards out of a total of about a mile. The expenditure on the whole undertaking amounts to date to some £114,000 out of an estimated total of £155,000.

Bradford.

The Esholt sewage works, which, as our readers are aware, have been under construction for a considerable number of years, are now, although not completed, dealing with the whole volume of sewage, and on September 28th Mr. Arthur Greenwood, late Minister of Health, put into operation the fifty-third complete acre of bacterial filters. An experimental lake 10 acres in extent is now in operation for final clarification, and is giving results of considerable interest. The water in this lake is kept as nearby as possible at 6 pH and it contains enormous numbers of cyclops and other samples of animal life. Sludge accumulated in the forty precipitation tanks, covering some 13 acres, continues to be pressed for the extraction of grease.

Brighton.

All the work in connection with the reconstructed sewer outfall at Portobello was completed during the past twelve months, and the electrically-operated pumping installation was in full commission before the end of the year. The total cost of the scheme was £77,764. The Patcham sewerage and drainage scheme, which is to cost £44,000, is well in hand and will, it is expected, be completed early this year. It is interesting to note that these works, as well as that for roads and sea defence, are all being carried out by direct labour and that most satisfactory results are being achieved.

Broadstairs.

The Broadstairs main drainage works, which are nearing completion, consist of a high-level intercepting sewer, together with various lengths of branch sewers, screen chambers constructed in the base of the cliff at North Foreland, and the extension of the existing 27in. diameter sea outfall, together with a new outfall of 30in. diameter. The sewage, before it is discharged into the outfall pipes, is screened through vertical screens with ¾in. spaces, and the screenings are removed by automatic raking gear, and then chopped up or disintegrated by means of Stereophagus pumps, and thence discharged through the outfall. The screens were brought into operation and the whole of the works were finished, with the exception of about thirty pipes for the sea outfalls, which still have to be laid. The work of laying them has been suspended during the winter months, but operations will be begun again in the spring, and it is anticipated that the whole of the works will be completed before next summer season. The two outfall pipes are to be carried for a distance of approximately 1000ft. beyond low-water mark of ordinary spring tides. The total cost of the works will amount to approximately £100,000.

Burnley.

Considerable progress was made during the year on the reconstruction of the Duckpits and Wood End Sewage Disposal Works and of the main outfall sewer, which is being carried out with the assistance of a grant from the Unemployment Grants Committee. Of the main outfall sewer, which consists of 54in. diameter and 36in. diameter cast iron pipes, with "Victualic" flexible joints, which is being laid by Mr. A. Waterman, of Leeds, about 1 mile was completed by the end of the year. Unstable ground was encountered for a length of about 150 yards on this sewer, and the pipes had to be supported on piles varying from about 18ft. to 22ft. long. The general contractors for the work at the Wood End works are M. and J. W. Heap, Ltd., who have almost completed the construction of the tanks for the activated sludge plant. The engineering work at the Duckpits Works, which is being effected by direct administration, consists of adaptations of preliminary sedimentation tanks for use as storm tanks, improvements to the remainder of the sedimentation tanks, and the provision of new detritus tanks and screen chambers, &c. Contracts for plant have been entered into with Ames Crosta Mills and Co., for the "Simplex" surface aeration machinery; with Messrs. Whitehead and Poole for screens; with Adams-Hydraulics, Ltd., for a detritus dredger; with George Kent, Ltd., for flow recorders; and with Tangyes Ltd. for sludge pumps—all of which plant is in course of fabrication. The installation of an experimental sludge digestion and gas collection plant was completed at the Altham sewage disposal works of the Corporation, and valuable data are being obtained from it. In addition, sundry small alterations were made in the sewerage system of certain districts in the town, and a comprehensive scheme providing for relief sewers in the eastern district is under consideration.

Coventry.

During the year considerable progress was made with various works. The Allesley sewerage scheme, work on which was begun in 1929, was completed by W. H. Jones and Son, Ltd., of Coventry, in February last, the final cost being approximately £16,000. The construction of the new sewage disposal works at Finham was well advanced by the end of the year and work to the value of some £60,000 was done by the contractors, S. Johnson and Son (Mirfield), Ltd., of Mirfield, Yorks. The detritus tanks, sedimentation tanks, bacteria beds and humus tanks were all completed, and the erection of the pumping stations, transformer and screen houses, &c., is well in hand. The whole of the granite filtering media has now been delivered and placed in the beds. It comprises some 45,000 cubic yards of stone, which has been supplied by Messrs. J. G. Gray, of Coventry, at a cost of approximately £33,000. It is expected that the works will be completed and put into operation about July or August next. Work on the construction of the new main outfall sewer was begun in April last, and approximately half of it has now been completed. This sewer, which is egg-shaped and will be some 2¾ miles in length, varies in size from 2ft. 8in. by 4ft. to 5ft. by 7ft. 6in. It is being constructed in mass concrete and for a distance of a quarter of a mile it is to be in tunnel, the tunnel varying in depth from 20ft. to a maximum of 61ft., the ground traversed consisting generally of sandstone. The contractors are Messrs. A. Waddington and Son, of Sheffield, and the amount of the contract is £56,000. The Corporation's programme of flood prevention schemes and the widening of river bridges was further proceeded with, most of the work being done by direct labour under the supervision of Mr. E. H. Ford, M. Inst. C.E., the City Engineer.

Derby.

Work on the extensions of the sewage disposal works made good progress during the year. The construction of the filters and humus tanks was nearly completed, what remains to be done being chiefly the filling of the filters, the erection of the distributors and the necessary connections to existing culverts. A contract for the construction of detritus pits, the pumping station, rising mains and a bridge over the Derwent was entered into and the work started. Progress on the river Derwent improvement scheme at Derby has so far been confined to excavating the lowest of the relief cuts and the disposal of the material in flood banks, the construction of a weir at the head of the cut and of a reinforced concrete bridge across the cut near its lower end.

Ilford and Barking.

The work carried out during the year in connection with the Ilford and Barking joint main drainage scheme included the laying of new sewers and joint intercepting sewers varying from 30in. to 74in. dia-

meter, which are to deliver the combined sewage flow to a proposed new pumping station which is to be equipped with machinery capable of lifting about 70,000,000 gallons of sewage and storm water per day. The sewage will be pumped to the London northern sewer outfall through two 30in. pumping mains, while the storm water will be pumped into proposed storm water tanks of about 1¼ million gallons capacity. The contracts for the pumping station and the tanks will be entered into shortly. The pumping mains cross the Barking Creek by means of a 7ft. 6in. diameter cast iron segment tunnel with shafts on each side of the river. That work, which was carried out by the aid of compressed air, was completed shortly before the end of the year. The total cost of the scheme will amount to about £180,000.

Leeds.

The sewage of the city of Leeds is, as our readers are aware, disposed of at two main outfall works which are situated, respectively, at Thorpe Stapleton, about 3 miles from the centre of the city in a south-westerly direction; and at Rodley, about the same distance in a north-westerly direction, but within the urban district of Horsforth. The first instalment of the works included in the former is nearing completion. During the year the third unit of sewage purification settlement tanks at the low-level works was finished and put into commission, the contract amount being £25,000. The construction of a lime mixing house, lime unloading shed, plant, &c., were begun, and good progress was made, the contract amount being about £10,000. The sewage works at Bodley were extended during the year to treat additional sewage from neighbouring urban districts situated on the west of the city boundary.

London.

The principal main drainage works carried out by the London County Council during the past twelve months were as follows :—

Abbey Mills Pumping Station.—The first section of the reorganisation of the station by substitution of eight electrically-driven centrifugal pumps, each of 125 tons per minute capacity, for the old beam engine sets was completed. Four electric pumps are now at work and it is intended to proceed with the installation of the remaining four pumps early this year. The total pumping capacity of the station will then be 2100 tons per minute.

Northern Outfall Works, Beckton.—A new reinforced concrete jetty 550ft. long and 16ft. wide was completed and the reconstruction in timber of the western arm of the pierhead, 235ft. long and 25ft. wide, was begun. Additional purification plant for the treatment of sewage by the activated sludge method was installed and is in operation.

Lots-road Pumping Station.—The reorganisation of the Lots-road storm-water pumping station, entailing the substitution of five oil-driven centrifugal pumps, each of 175 tons per minute capacity, for five smaller gas-driven sets of approximately one-third the capacity, was begun. A cast iron tunnel, for the Walham Green storm relief sewer, 7ft. and 9ft. diameter and about 1 mile in length, from North End-road, Fulham, to Lots-road pumping station, was completed, and the concrete lining and weir chamber are in hand.

Deptford Pumping Station.—The reorganisation of the Deptford pumping station by the substitution of centrifugal pumps for steam-driven ram pumps was put in hand. Two electrically-driven pumps of 60 tons per minute capacity and one of 90 tons per minute capacity, for dry-weather flow, were put in and are already at work. Five oil-driven storm-water sets, of a total capacity of 990 tons per minute, are to be installed during the present year. The Deptford storm-water culvert, 11ft. 6in. diameter, from Deptford pumping station to the river Thames, was nearly completed, and the construction of a short diversion of the Ravensbourne and Lee Green sewer, 4ft. 6in. diameter, was well advanced.

Storm Flooding Relief Works.—The river Graveney improvement works, involving the construction of an open concrete aqueduct, 11ft. to 13ft. 3in. wide, 5ft. 6in. to 7ft. deep, and about 1 mile in length, was completed.

General.—In addition, a number of important repair and maintenance works were carried out during the year. The construction of escalators at a number of the tube railway stations is necessitating the diversion of large sewers of the Council. The most important of these are at the Monument, Leicester-square and Knightsbridge stations.

Manchester.

The work on the first section of the Wythenshawe main drainage scheme was almost completed. It comprises circular sewers from 8ft. 3in. diameter to 8ft. 6in. diameter, a semi-circular storm water overflow 12ft. 6in. by 7ft. 11in., and a 4ft. 9in. diameter outfall with a syphon under the river Mersey.

Work No. 14 of the city's main drainage scheme was begun last year. It comprises a 4ft. 6in. diameter sewer, 1233 yards long, at an average depth of 88ft., and 9in. and 15in. pipes at approximately 25ft. deep. A tunnel is being driven in two directions from one shaft and in all a length of 1133 lineal yards has been constructed in cast iron segments. It will be lined with brick and concrete. The tunnel is being excavated with a shield under compressed air at pressures up to 7lb. per square inch.

The work on the new activated sludge units for the Davyhulme sewage works extension was continued. It should be completed in 1933. These units will work under the air diffusion, the bio-aeration, and the "Simplex" surface aeration processes respectively, so that interesting comparisons should be forthcoming.

Sheffield.

During the year four additional units of the bio-aeration plant, capable of treating one million gallons each of sewage and the appropriate quantity of storm water per day, were completed and put into operation. They complete a scheme of twenty-two units which are treating the whole of the sewage from a population of 510,000 people. A scheme was also in progress for the construction of twelve acres of sludge drying beds, about half of which were completed and are now in use. The necessary electrically driven pumps, pump wells, and sludge mains were also put into operation during the year. These works were estimated to cost £134,000 and will, we understand, be completed for that sum. The work was carried out by administration, with a grant from the Unemployment Grants Committee. A scheme for a new sewage disposal works to treat the sewage of the Woodhouse, Woodhouse Mill, and Richmond districts of Sheffield has been sanctioned by the Ministry of Health, and is now in progress, a sum of £36,000 having been sanctioned for the purpose. The works will consist of a bio-aeration plant, in which many new features are to be incorporated, a sludge digestion plant, and specially designed sludge drying areas. This scheme is also aided by a grant from the Unemployment Grants Committee and is being carried out by administration. A small sewage scheme for the treatment of the sewage of the Norton Backmoor area of Sheffield, comprising pyramidal type settling tanks, a percolating filter and the necessary pyramidal type humus tanks and sludge drying area, was also completed.

Swansea.

A beginning was made with the construction of the first instalment of a main trunk sewer, which forms part of the main drainage scheme designed to cater for the needs of the whole Borough of Swansea, as enlarged under the Swansea Extension Order of 1918. The sewer will extend from near the Mumbles Head, where it will have an outfall into the Bristol Channel, to Swansea, and run thence along the Swansea Valley to near the borough boundary at Clydach, a distance of about 11 miles. The estimated cost of the sewer, together with auxiliary works and subsidiary sewerage schemes, is £1,600,000. The scheme will provide for intercepting the existing sewers as well as for draining many large unsewered areas which were added to the borough in 1918. The major portion of the borough will be drained to Mumbles Head, the remainder being drained by an independent system to the tidal waters of the Afon Lliw. The section now in hand will extend around the shore of Swansea Bay from Mumbles Head to Brynmill, a length of about 4½ miles. The works comprise (*a*) two 5ft. diameter cast iron sea outfall pipes; (*b*) four parallel storage tanks—in brick and concrete—each of a size 16ft. 6in. wide by 10ft. high and 2000ft. in length, tunnelled in limestone rock under the Mumbles Hill and including screening plant and chambers, &c.; and (*c*) the main trunk sewer in brick and concrete construction, varying from an egg shape of 7ft. 9in. by 5ft. 2in. to a circular barrel of 5ft. 6in. diameter, together with incidental works of river and stream diversions, syphon crossings, &c. The estimated cost of this section, which is being carried out by contract, is £686,500, and it will take three years to complete. The continuation of the main trunk sewer to its termination at Clydach will be undertaken as the second instalment of the scheme. The whole scheme is subject to a Government grant and will take five years to complete. The sewering of the Cockett, Fforestfach, and Waunarlwydd districts was also partially carried out during the year, the length of new sewers that have been laid being 6½ miles.

Wolverhampton.

The new detritus tanks, which are furnished with mechanical grit scrapers and elevators, were completed and have been in use for some months. Two new primary sedimentation tanks are in course of construction. They, too, will have mechanical scrapers, and their total capacity will be one and a-half million gallons. The existing tanks, which are also of one and a-half million gallons capacity, will form secondary settlement tanks. Eight sludge digestion tanks of a total of over four million gallons capacity are nearly completed, while some 12 acres of sludge drying beds are in course of construction and should be completed this year. The construction of seven humus tanks of nearly one million gallons capacity is well advanced. The order for 6 acres of filter beds was placed a few months ago and a good start was made with the excavation. Meanwhile nearly one half of the sewage is being treated in the bio-aeration plant and the remainder on land. The sludge is sent direct to farmers, in the liquid state.

France.

The scheme for dealing with the sewage from all the Paris suburban areas by a system of collectors that was to have been begun during the year was abandoned when it was found that the problem of pumping such a huge volume of sewage and used water, as was involved, to the farms it is proposed to lay out beyond Achères, offered no reasonable hope of practical solution. Therefore, after abandoning five different projects in three years, the Paris Sanitary Commission had to review the situation all over again in the light of the latest developments in sanitary engineering, particularly in the separation of used water from sewage. There continues to be considerable opposition to the creation of new sewage farms, and other means of treating sewage are being experimented with, but it is hardly likely that a new scheme will be put in hand for some time to come. The system of collecting sewage and household refuse by vacuum, which has long been in successful operation at Villeneuve-Saint-Georges and Sables-d'Olonne, was installed during the year in one of the districts of Rouen, and it is also being laid down at Dieppe. Recently the German firm of B.A.M.A.G. completed an incineration plant at Lyons on account of reparations. It has three furnaces, designed to deal with 420 tons of refuse a day, and a fourth may be added later on to bring up the total to 550 tons. The combustion of the refuse raises steam for three groups of turbo-alternators producing more than 6000 kW, which is used for electric omnibuses and other municipal services. The Beccari system of dealing with vegetable refuse by fermentation, which is employed at Cannes, has been developed into another process that aims at reducing the time necessary for fermentation and increasing the capacity of the plant, and an installation of that kind is being laid down at Avignon. In the South of France, where the refuse is mainly vegetable and cannot readily be incinerated without the use of coal, the fermentation process continued to make headway.

A Bucket Pin Locking Device.

A NEW device for locking the pins of bucket dredger chains and similar appliances, which has recently been brought out by Hadfields, Ltd., of Sheffield, is illustrated by the accompanying engraving. It is known as the Kent bucket pin locking device, and Hadfields have secured the world rights for its manufacture and sale.

The difficulty with pins in this class of service is, of course, that they tend to turn in the socket eyes as the chain of buckets goes over the tumblers, on account of the very heavy pressures to which they are subjected.

KENT BUCKET-PIN LOCK

If they do turn wear will take place and this wear may possibly be uneven on the two sides, with the result that the chain will run out of line.

In order to overcome this trouble the pins are ordinarily provided with L shaped heads, which fit into recesses in the lugs. They are then bolted down to prevent their working out endways. Ordinarily, the sides of the head are parallel and they are fitted as snugly as possible into the recesses, but the slightest amount of play soon becomes accentuated and the pins wear in the eyes.

In the Kent arrangement the head of the pin is made with a divergent taper, one side of which fits against the side of the recess in the lug. The other side is supported by a wedge, as shown in the illustration, which can be drawn up by a bolt and nut to keep the two parts in tight engagement. It is obvious that if any slackness should develop a turn of the nut will take it up.

The idea is also applicable to existing bucket pins with parallel heads and recesses, by machining away the head to provide a sloping face and then arranging a wedge, pulled up against a bridge piece, to fill up the intervening space.

THE position of personal assistant to the chief mechanical engineer, Great Western Railway, vacant by the removal of Mr. W. A. Stanier to the L.M.S. Railway, has been filled by the promotion of Mr. J. Auld.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Old and the New.

THE year 1932 should have little difficulty in surpassing its immediate predecessor's trade record. The past twelve months have yielded industry such poor returns for its outlay, and the worries and anxieties which manufacturers have encountered, have been so trying to the nerves, that I feel it would be wise in this letter to dismiss the year 1931 with as few remarks concerning its trade characteristics as possible. Almost everyone looks upon it as a black year. Demand for all kinds and classes of products has been poor, selling prices have fallen in the attempt to keep business, and profits have dwindled so that in many instances trading accounts have shown a loss. Much had been expected from the year 1931. Little acceptable was received. What has 1932 in store for us? On 'Change in Birmingham this week some optimism has been shown in certain circles, but it cannot be said that all manufacturers or engineers are enamoured of the prospects. There are trade movements which encourage hope, however. Some Midland industries will, for a time at any rate, receive a measure of protection denied them during practically the whole of 1931, and in them the outlook is decidedly brighter. In the heavy trades—iron and steel—there are expectations that the National Government will eventually realise the plight of those industries and accord them similar or other protection from the devastating effect of unequal foreign competition. The changed outlook in the export markets as a result of the abandonment of the gold standard and the efforts being made to foster trade with the Colonies should each have a beneficial effect upon industrial conditions in this area. One may therefore look to the year 1932 with a certain degree of cheerfulness and hopefulness, and with a firm belief that some progress at least will be made towards that return to a prosperous state of industry for which all were striving so diligently when the year 1931 went out and efforts towards which will be intensified as the year 1932 progresses.

Engineering Outlook.

Engineers in the Midlands and Staffordshire have generally, with the exception of those engaged in the electrical industry, gone through a most difficult and trying twelve months, and even to-day, though there are a few signs of awaking interest, the outlook is not considered to be bright. There is a marked scarcity of orders of any size, and in the constructional branch recent events have rather tended to make matters worse than to improve them. Some of the biggest constructional engineering firms in this district find it most difficult at date to keep their yards employed, and so severe is competition for the work available that prices are cut to the extent of ruling out the possibility of profits. Mechanical engineers have been but moderately engaged, and while the outlook here is slightly better than in the constructional branch, it is not such as to encourage high hopes. Rolling stock engineers are better placed, and recent additions to order books have enabled the leading Birmingham firms to carry over a goodly amount of business to the year 1932. Not only so, but recent orders are such as to encourage the hope of improved demand having to be met in the year now current. The lighter the branch of engineering work, the greater has been the activity during the past twelve months, and, though all classes of engineers are hoping for improved conditions, there are many who fail to perceive any evidences of an amelioration setting in during the first quarter of the New Year. The economy rendered imperative by financial stringency and the depressed industrial conditions of recent months have severely affected all classes of constructional engineering, and it is feared it will take some considerable time before matters can be sufficiently straightened out for progress to be made with schemes necessitating the services of structural engineers. Many schemes were abandoned during the past few months, others have been laid aside, while others contemplated or under consideration have been left incomplete. Until such time as the situation changes it is feared engineers in this area will have but a lean time. They are not wholly pessimistic, however. They greet the New Year with hopes based more on sentiment than on discernible tokens.

Electrical Engineering Prospects.

The electrical industry in this area has on the whole proved an exception to the bulk of local trades in that it has experienced during the past twelve months a good run of business. It has not entirely escaped the general trade slump, but it has fared much better than perhaps any other industry in this area. Not only so, but the prospects for the coming year are really bright. Many of the firms in the Birmingham district are in a strong position, and additional valuable orders are almost constantly coming to hand in the various branches of the trade. In the heavy equipment line, several firms have an excellent carry-over of orders from the year 1931, and there are indications of a prosperous year ahead. The use of electricity continues to grow for industrial power as well as for domestic power and lighting purposes, and the opening up of the rural areas, bringing an increasing call for equipment and fittings, is now proceeding apace. One of the most recent orders secured in this district has reference to railway rolling stock. The General Electric Company, Ltd., has been instructed to supply the electrical equipment of the new rolling stock required for the augmentation of the London, Midland and Scottish Railway services on its Euston, Watford and Broad-street, Richmond, sections. The light electrical trades in this area have experienced something of a rush during the last few months. It has been one of the brightest features in the local electrical trade situation, and a Wolverhampton firm has just acquired a large factory, formerly used by a well-known motor cycle firm, to cope with the situation. Plans have not yet been announced, but it is stated that the premises will be put into commission at the earliest possible date, and that new lines of business may be introduced. Electrical engineers have much to congratulate themselves upon, both as regards the achievements of the past year and the prospects for the one now being entered upon. It only requires a resumption of activity in the shipbuilding yards to make the position of the electrical industry in the Birmingham area secure.

Electricity Records.

The Birmingham electricity authorities have had an excellent year, and a couple of records have been established during what has undoubtedly been a most difficult trading period. The Birmingham Electric Supply Committee reports that the number of new consumers connected to the system during the past month was 1650, making a total of upwards of 24,000 additional consumers connected during the year—a record in the history of the undertaking. A new record was also recently established when a day's output from the power stations was well over 2,000,000 units, being an increase of 8¼ per cent. over the record made in December, 1930.

Market Position.

The iron and steel market has been very quiet this week, negotiations for fresh supplies of material being withheld until the January quarterly meeting. Many of the iron and steel consuming works have only put in a short week, while some have not operated at all. The work in hand in many cases was cleared off before the Christmas holiday, and stocktaking is going on in many establishments. Producers of material are looking to the quarterly meeting to provide them with additional orders, which in some cases are much needed. Derbyshire and Northamptonshire blast-furnacemen have increased their stocks of iron somewhat over the holiday period, but stocks are so much smaller than they were three months ago that they are not even now disconcerting. Having had a fairly good run of business during recent months, smelters start the New Year favourably placed. There are few, if any, producers of other classes of material who, like makers of pig iron, have already disposed of the bulk of their first quarter's production. Selling prices are as a week ago. Derbyshire No. 3 foundry is £3 6s. per ton and Northamptonshire £3 2s. 6d., with forge grades at £3 1s. and £2 17s. 6d. respectively. These prices are 5s. per ton lower than those which ruled twelve months ago. The Staffordshire finished iron trade is working on hand-to-mouth lines, and the outlook for the New Year is not pleasing. In no section of the trade is employment on a regular basis. The best bar branch awaits improvement in the engineering industry, while the common bar producers seek relief from Continental competition. Values which are now steady show falls of 10s. or more per ton when compared with the end of last year. Marked bars now £12 were £12 10s., the minimum for Crown bars now £9 5s. was £10; nut and bolt bars, to-day almost unsaleable at £8 7s. 6d., commanded £9 to £9 5s. a year ago; gas tube strip at £10 10s. is 7s. 6d. per ton cheaper than at the end of 1930. Business in steel expands slowly and steel masters in this area anticipate continued progress. The past year has at best been moderate as far as business is concerned, and improvement will be welcomed. Steelmasters generally believe there are better times in store, and, to that end, they are reconditioning plant in readiness. Selling prices of finished steel are as quoted twelve months ago, but there has been some variation in rebates to users of British material only. Steel half-products have met with severe competition during the year, and values have been forced down. Small rolled bars, which were £7 7s. 6d., are now £6 17s. 6d.; billets, which were £5 12s. 6d. upwards, are now £5 7s. 6d. The most notable fall, however, is that which has taken place in galvanised sheets, where the basis for 24-gauge corrugateds has dropped from £11 5s. per ton to £9 5s. Business has improved slightly of late in this department, but makers have been unable to improve upon this selling price.

The Coal Quota.

For the first three months of 1932 the coal quota for the Cannock Chase coalfield will be much the same as for the first period of the winter. It is computed that the output figures for the year for that coalfield will be much as in the preceding twelve months, namely, in the region of 5,000,000 tons. The general view taken locally is that regulation of output and prices is helping definitely towards the sound stabilisation of conditions in the industry, and that employers and employed stand to gain by the new policy. The Board of Trade report on the working of the Coal Mines Act stated that during the past year there was no arbitration on the application of the local organised coalowners, with a view to an increase in the local allocation, but that there had been an appeal by the Holly Bank Coal Company for an additional quota, which was being granted. In the first quarter of last year complaints were made that the effect of the quota system was to throttle the local industry, because some of the pits were not allowed to produce coal for which they had orders. Pressure was brought to bear on the responsible committee, and there was an improvement in the Cannock Chase situation. Regulation of coal prices has been carried out in the area in accordance with the Act. Considerable difficulties arise in setting up a list covering about 400 grades of fuel, but on the whole the system has worked well and price regulation is to-day more in hand than it has been at any time.

Warwickshire Miners' Wages.

It is satisfactory to know that the rate of wages for miners in the Warwickshire coalfield has been stabilised for the first three months of the year, and perhaps the more so as they are to be on a high level. Through the Joint Wages Board, the Warwickshire Miners' Association has accepted the offer of the Coalowners' Association of a stabilised rate of wages of 48 per cent. on the 1911 basis as from January 1st to March 31st. Only for one month—in 1928—has the rate been as high as 48 per cent. on the 1911 basis since the agreement of 1926 was entered into.

To Increase Automobile Production.

In order to expedite the production of motor cars and to relieve the pressure on its Stoke works, the Triumph Company has taken over an additional factory in Coventry. Previously, the engineering departments of the works were able to produce chassis in greater numbers than could be dealt with by the body-making and assembly shops. The new factory—the eighth in the Triumph group—will allow an even balance in that respect, and will enable the output of complete cars to be increased by over 30 per cent.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Industrial Prospects.

PROSPECTS for the engineering and allied industries during 1932 are coloured by the unsettled economic and financial conditions throughout the world, and in Lancashire, at the moment, contrary to the usual experience at this time of the year, there is a tendency generally to take a very sober view of the outlook, and one which is divorced entirely from the seasonal attitude of sentimental hopefulness. The welfare of many branches of engineering locally is largely bound up with the fortunes of the cotton textile industry, and although the position of the latter has recently been better than it was in the first nine months of the year, its future is still very uncertain. Textile engineering concerns in some instances have experienced a measure of improvement, and it is believed that, on the whole, conditions in the locomotive building industry at the moment are not quite so depressing as they have been for some considerable time. A number of engineering concerns in the district engaged on the production of speciality products are able to maintain a fair degree of activity, and the same may also be said of the heavy and light electrical industries. Machine-tool makers, latterly, have also been rather better situated. There are thus one or two moderately bright spots, but there are also quite a number of dark ones, constructional engineering being among the darkest, and it is with no great confidence that many firms are facing the New Year.

Aircraft for South America.

A. V. Roe and Co., Ltd., of Avro Works, Newton Heath, Manchester, are reported to have secured a large order for Avro Armstrong-Siddeley training aeroplanes for South America. The machines are to be constructed at the Newton Heath works.

Electrical Developments.

The Electricity Committee of Preston Corporation propose to borrow the sum of £235,000 for the provision of additional mains, services, transformers, switchgear, meters and consumers' installations expected to be required during the next three years. A Bury Corporation scheme for a change-over from D.C. to A.C. in the centre of the town, estimated to cost about £20,000, has been approved by the Electricity Commissioners. The annual report of the Electricity Department at Bury states that, largely in consequence of industrial depression, the consumption of current showed a decline during the past year of rather more than 12 per cent.

Non-ferrous Metals.

Activity on the non-ferrous metals market since last report has naturally been seriously influenced by the Christmas holidays, particularly as regards the demand from industrial users, speculative interests being relatively the more prominent. For the time being, the effect of the agreement that has been reached among world copper producers on the questions of output curtailment and marketing has been fully discounted, and after the previous week's rather substantial advance in quotations there has been a certain amount of reaction, the loss in standard brands being about 30s. a ton on balance, or about half of the previous gain. Similarly, in the tin section prices have given away, although they are still higher than they were a fortnight ago. The week's loss has been in the region of 30s. a ton, although growing confidence in an improvement of the statistical position of this metal is a feature of the market. For the time being, the demand for lead is on quiet lines, but offers in this section seem to be strongly controlled and values at the moment of writing are 5s. above last week's parities and are thus back to where they were early in December. The spelter market has been rather featureless, and values have eased to the extent of between 7s. 6d. and 10s. a ton compared with a week ago.

Iron and Steel.

Virtually, every section of the iron and steel markets during the past week has been afflicted by its customary year-end dullness, and business has been very slow, indeed. In the early days of the present week an occasional contract for pig iron for delivery over the first quarter of 1932 was booked, but in other respects the foundry iron market has been almost at a standstill, with, moreover, deliveries to local works held up pending the completion of stock-taking operations. In the meantime, prices of all descriptions of pig iron have been maintained at the old rates, with quotations for finished iron also unchanged, and the demand at the moment exceptionally poor. Inactivity has likewise been the keynote in the steel markets, both in home-produced and imported materials, with no appreciable changes in values to report. There is believed to have been a slight change for the better in the locomotive building industry, but in the heavy steel-consuming industries generally, and especially in the important constructional engineering branch, the outlook for the immediate future is not promising. Among alloy steel makers, however, there is some hope that the better trade experienced in the closing months of the year will be resumed when trading conditions recover from the influence of the holidays.

BARROW-IN-FURNESS.

Hematite.

There is not a single bright spot in the hematite pig iron trade. Business has shrunk during the holidays,

and although the present output is restricted stocks are increasing. The fact that the requirements of the local steel departments are low, accounts for some of the increase in stocks. Ulverton, which closed down some months ago, is still idle, and it is just possible that now this North Lonsdale works are amalgamated with the Millom Company, the Ulverton furnaces will only be put into blast when Millom is unable to cope with the orders held. Foreign trade has fallen off considerably these last few months, despite the fall in the pound, which points to thin trade in both the Continent and America. The home trade is very quiet, and South Wales is not taking much pig iron at present. The iron ore trade, both native and foreign, is poor in consequence of the slackness in the iron trade. The steel market is quiet, but it is expected that the rail departments will restart in the New Year; but by present signs, there are not sufficient orders to assure any company of continuous working. After a brief holiday the hoop and small section mills have got to work again. Vickers-Armstrongs' holidays were the shortest for many years.

SHEFFIELD.

(From our own Correspondent.)

The Closing Quarter.

THE year's operations in the Sheffield steel trade came to an end, to a great extent, at Christmas, for most of the works have had holiday for the whole, or the greater part, of this week. The last quarter proved to be the best of the whole year, but it was satisfactory in only a relative degree, and it did not end as well as it began. The suspension of the gold standard was followed by a considerable improvement in most branches of trade, and consumers showed a welcome readiness to buy for future use. But the revival soon tapered off, and at the close of the year conditions were much the same as they had been three months before. This applies especially to the open-hearth steel section, in which producers have latterly been finding it difficult to dispose of their output, orders for bulk quantities being very scarce. A similar state of things is found in the heavy manufacturing departments. On some of the lighter and more finished sides of the trade, the position is more favourable, as a number of firms are gaining a certain amount of export business, owing to reduced prices of their goods to the overseas buyer. The purchasing power of the principal markets abroad is, however, low, and in consequence of this the export trade has not progressed to the extent that might otherwise have been expected. Prices of iron and steel material have, for the most part, been stationary during the quarter. The scrap market has shown a gain, and, although it is said to have lost strength lately, sellers of basic scrap are still holding out for 42s. per ton.

Railway Work.

The home railway companies are still pursuing a very economical policy, and the local plants devoted to the production of axles, tires and springs are short of work, as they have been for a considerable time. The latest order to be announced is one placed by the Railway Tender Board, Johannesburg, with the Steel, Peech and Tozer branch of the United Steel Companies for the components of 500 pairs of wagon wheels and axles, the assembly of which is to be carried out by Owen and Dyson, Ltd., of Rotherham. It is also of interest to Sheffield to know that Taylor Bros. and Co., Ltd., of Trafford Park, which is one of the firms in the Engish Steel Corporation, has secured an order from the same source for 1500 pairs of wheels and axles.

A Stainless Steel Aeroplane.

The adaptation of stainless steel to the construction of aircraft has been progressive, and a further stage has now been reached, in which that material is to be used for every part of an aeroplane. The use of stainless steel in the hulls of the great "Supermarine Napier" flying boats proved the success of the metal in resisting the corrosion of sea water, while a considerable amount of stainless steel was also incorporated in the "Gloster Napier" racing machines built for the Schneider Trophy contest. Now, as the result of research in the laboratories of Thos. Firth and John Brown, Ltd., Sheffield, a stainless steel has been evolved which can be drawn into strips light enough for use in aeroplane wings. The object of the experiments was to discover a type of the steel which could be drawn into very thin strips and still retain the necessary tensile strength, and it is understood that a strength of 60 tons has been achieved. It is probable that the Air Ministry may place a good order with the firm. A complete aeroplane is to be constructed, in which not only the wings and fuselage, but every nut, bolt, rivet and control cable will consist of stainless steel.

Company Announcements.

Several company reports or dividend announcements have appeared about the year-end, but it cannot be said that they are of a pleasing character. The United Steel Companies report that the combined trading profit of the company and its subsidiary and associated companies, before providing for depreciation, interest charges of the company and its subsidiary and associated companies for income tax, amounted, for the year ended June 30th last, to £259,202, and that the surplus of profit for the two years ended on the same date, which includes the profits for the period prior to the incorporation of the company, is £316,588. It is recommended that £200,000 be appropriated to reserve for depreciation, and the balance of £116,588 be carried forward. The report of Steel Industries of Great Britain for the year ended September 30th last states that no dividend has been received during the year upon the investment in the United Steel Companies, Ltd., and the profit and loss account shows a loss of £11,837 for the year. After deducting the credit balance brought in, there is a debit balance of £6436. For the current year the directors of the United Steel Companies have notified the directors of this company that they are unable to declare an interim dividend, and, accordingly, the dividend on the 6¼ per cent. cumulative preference shares of Steel Industries of Great Britain is not being paid on January 1st. Hadfields Ltd. state that by reason of the continued depression in trade and the consequent need of conserving the company's resources, the directors have decided to defer payment of the preference dividend due on December 31st. The dividend is now one year in arrear. Thos. W. Ward, Ltd., report a slight improvement in trade, but, in view of the unsettled conditions which still prevail, the directors have decided to postpone the payment of the quarterly dividends on the preference shares due December 31st. Sheffield Cutlery Manufacturers, Ltd., report a loss of £516 during 1930, compared with £980 in 1929. They state that "the world-wide adverse conditions of trade last year, and the intensity of competition within the industry, are in large measure the explanation of losses sustained by the subsidiary companies."

Low-temperature Carbonisation.

Several localities have been mentioned as likely places for the establishment of plant for the development of the new Salerni process of low-temperature coal carbonisation, which Sir Eric Hambro has announced his intention of financing. Sheffield, as the centre of one of the most important coalfields in the country, and as the place where the details of the process were perfected at its University, is naturally anxious to have a works set up in its midst. With this end in view, the Lord Mayor has held a meeting, attended by representatives of the City Council, Cutlers' Company, Chamber of Commerce, and University, at which it was decided to send a deputation to the Commendatore Salerni. The Commendatore has replied that he will be very pleased to meet the deputation. It is also announced that Sir Eric Hambro is to visit Sheffield early in the year, and his consultations there may make it unnecessary for the deputation to see Commendatore Salerni.

Doncaster Prospects.

The Corporation of Doncaster has for some time been making energetic efforts to attract new industries to the town, and it is now announced to be in touch with two Continental firms who are contemplating establishing factories in this country and are disposed to consider Doncaster in a favourable light. A Corporation official states that negotiations have reached quite a hopeful stage. Several other firms, both Continental and American, have inquired as to the nature of the facilities available in Doncaster, and are comparing them with those in other towns.

Headlights for Pit Ponies.

The Staveley Coal and Iron Company has evolved and obtained the Ministry of Mines' approval for a type of pit pony lamp which is claimed to be superior to any others, which are at present only in the experimental stage. The company has been carrying out experiments for a considerable time, and it has been proved that the best results were obtained with a lamp complete in one unit, and fixed on the front of the pony's collar. The lamp is known as the "Davis Hunter" pony lamp, taking its title from the manufacturers, John Davis and Sons, Ltd., Derby, and Mr. John Hunter, general manager of the Staveley Company's collieries. Its weight is about 6½ lb., it is simple to attach, and its use will mean that ponies will work with less danger of accident and with greater comfort and confidence.

Chesterfield Water Supply.

A town's meeting at Chesterfield has approved of the promotion of a Parliamentary Bill for the formation of a joint board to take over and control the water undertakings of Chesterfield Corporation and Bolsover Urban Council. Some interesting details regarding the programme of the proposed authority were given by the Chairman of the Chesterfield Water Committee. He said that Whispering Well at Holymoorside could be developed at a cost of £24,000 to provide for Chesterfield's needs until 1939; but the requirement for 1946 would be 2½ million gallons per day, compared with the present consumption of 1¼ million gallons per day. Whaley Well, Bolsover, had been deepened at a cost of £2000, and the yield was now 1,200,000 gallons per day. The estimated cost of pumping and softening plant was £56,500, which included £16,600 for trunk mains to Chesterfield.

Hull Authorities and Humber Bridge.

The question of the proposed bridging of the Humber at Hull keeps well to the fore, and references to it are frequently to be seen in the reports of meetings of the various authorities which are interested in the project, for or against. There was one of these references at the meeting of the Humber Conservancy Board last week. The Solicitor to the Board had reported to the Parliamentary Committee that the promoters of the Bill had asked the Board's Parliamentary Agents for the plans and estimates of the tunnel mentioned in the Board's petition to the House of Lords, and he had instructed the agents that the Board were not prepared to incur the costs of so doing unless and until the Bill reached the Committee stage in the House of Lords. The promoters had inquired whether the Board were prepared to submit, without prejudice, clauses for the Board's protection, but this likewise had not been done.

NORTH OF ENGLAND.

(From our own Correspondent.)

Dismal Shipbuilding Returns.

THE intensity of the shipbuilding depression on the North-East Coast during 1931 is the conspicuous feature of the annual returns of ships built. Twelve months ago the condition of the industry was reported to be in a bad state, but hopes were expressed in some quarters that 1931 would see an improvement. These anticipations did not materialise. On the other hand, things appear to have gone from bad to worse, and the output is the smallest recorded for many years. A considerable number of yards have been without work entirely, and have not launched a single ship. This has especially been the case on the Wear, where only four establishments report seven launches, the aggregate tonnage of which is a meagre 8787 tons, though in another case a cargo vessel has been constructed and is ready for launching, but has, unfortunately, been thrown on to the hands of the builders, Sir J. Priestman and Co., Ltd. The best North-East Coast return is that of the Tyne, where twenty-two ships, with an aggregate of 147,354 gross tons, have been put into the water, though even these figures are much less than one-half of the previous year's output. The same may be said of the Tees, where the production has consisted of nine vessels, with a total of 38,990 gross tons. At Hartlepool and Blyth no new ships have been built. Some idea of the lack of work will be gathered from the fact that decreases of output have been as follows:—The Tyne, 42 vessels and 208,616 tons; the Wear, 33 vessels and 166,720 tons; the Tees and Hartlepools, 45 vessels and 72,427 tons; and Blyth, one vessel and 3433 tons. In other words, 121 fewer vessels, representing a diminution of 451,196 gross tons, have been built by North-East Coast shipbuilders in 1931 compared with 1930.

The Outlook.

For quantity of output, Swan, Hunter and Wigham Richardson easily take premier place again. The total tonnage of the fourteen vessels launched from their Tyne and Wear yards was 84,244 tons gross. Of this total, twelve vessels of 81,328 tons—including two floating docks—were launched from their Tyne shipyards, and two vessels of 2916 tons from their establishment on the Wear. While still enabling the firm to hold top position among North-East Coast shipbuilders, this tonnage is far short of the firm's 1930 output from the same two yards. Twelve months ago their return showed an aggregate of twenty-seven vessels launched on the Tyne and Wear, totalling 142,049 tons, so that there is a falling off of thirteen vessels and 57,805 tons. Many yards on the North-East Coast continue without definite orders for the coming year. During the last few weeks a few new vessels have been laid down by different builders, and there is a certain amount of work on hand, but, especially in view of the large quantity of idle tonnage waiting to get started again, the prospect of any influx of new business is far from bright. A few of the vessels which have been tied up at the buoys for some time have recently got into commission, and this is a hopeful sign. It can hardly be said, however, that it predicts anything like a rush of new trade, and the improvement will more likely be of a gradual character.

Cleveland Iron Trade.

There is an absence of feature in the Cleveland iron trade, and a resumption of ordinary market conditions is not looked for until after the New Year holidays. The outlook is regarded as uncertain, but now that producers in this district are able to compete with foreign makers on more favourable terms than for many years past, hopes are entertained that lost markets will be recaptured and new avenues of trade opened out. Accumulations at makers' works are increasing, as is usual at this time, when consuming works are closed. With the reopening of foundries and steel works next week, however, the limited make of pig iron will be inadequate to requirements, and movements may occur shortly in the direction of preparation to rekindle an idle blast-furnace or two. Aggregate stocks are heavier than is desirable, but promise to be substantially drawn upon in the near future. Prices are steady and firm, No. 1 Cleveland foundry iron being 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

There is a good deal of East Coast hematite pig iron in second hands, and quotations are unsteady, but merchants are not greatly underselling producers. Most of the moderate sales are to home users, but there are a few Continental inquiries. Makers ask up to the equivalent of ordinary numbers at 66s., but consumers claim they can purchase at a shilling less.

Iron-making Materials.

There is no market for foreign ore at present. Most consumers have large stocks. Blast-furnace coke of good average quality is quoted at 17s. delivered to North-East works, but business is light.

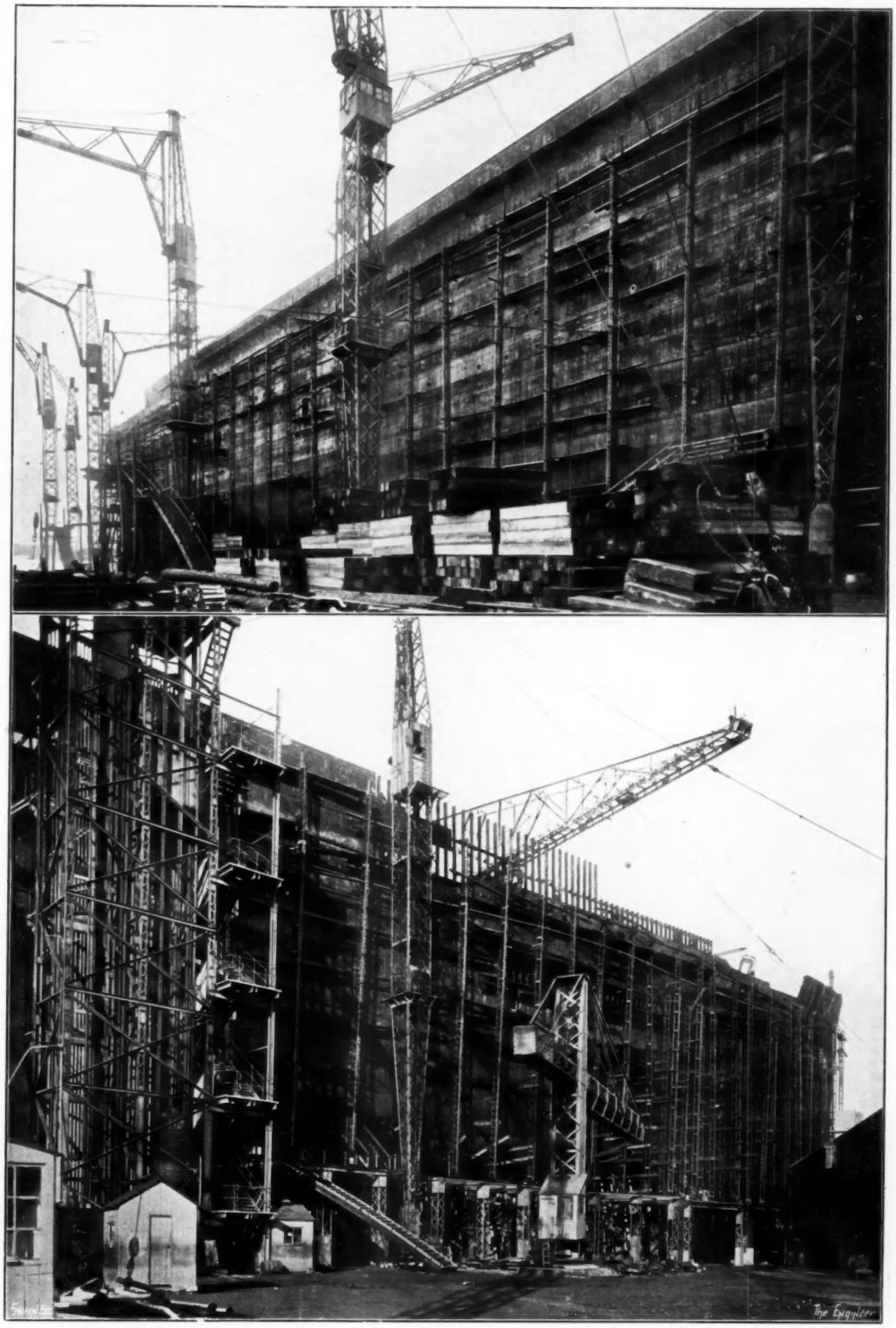
Manufactured Iron and Steel.

All the steel works are closed down until Monday. Quotations keep steady, but transactions are few and small.

The Coal Trade.

What had otherwise been good prospects for the Northern coal collieries have been clouded by the report that the German Government intends to impose a severe restriction on the imports of coal. It is said that the cut amounts to two-thirds—that is to say, the coal taken by Germany is to be reduced from 300,000 tons per month to 100,000 tons per month. It is regarded as a form of retaliation against the English import duties, which, of course, affect German products considerably. The curtailment, if it prove to be true, will be a blow to the North-East Coast ports, and particularly to the Tyne and Blyth, as they are among the principal suppliers of the Elbe ports. Official details are being awaited with interest and some anxiety. Previous to the report of the restriction by Germany there was every likelihood of the collieries in Northumberland and Durham working regularly in the early months of the New Year. Pits in the Blyth area are well placed for orders, and in other parts of the county some of the collieries have sold well into 1932. As the coldest weather is usually experienced from January to March, the seasonal demand has really not yet begun. The favourable rates of exchange have helped sales of best bunkers to the West Indies, and of coke nuts to the United

SHIPBUILDING IN 1931—PROGRESS ON THE NEW CUNARD LINER

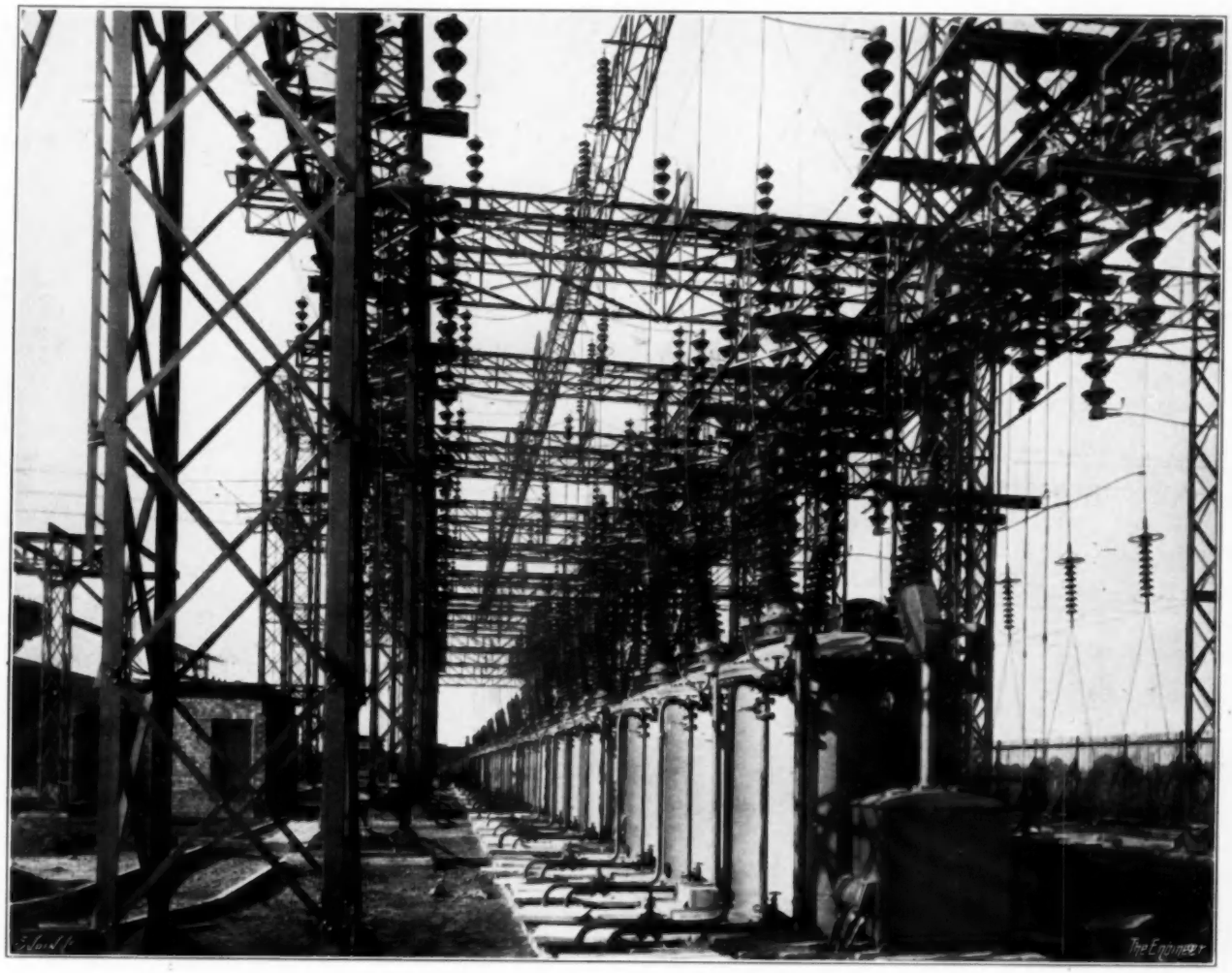


TWO BRIDGES OF 1931

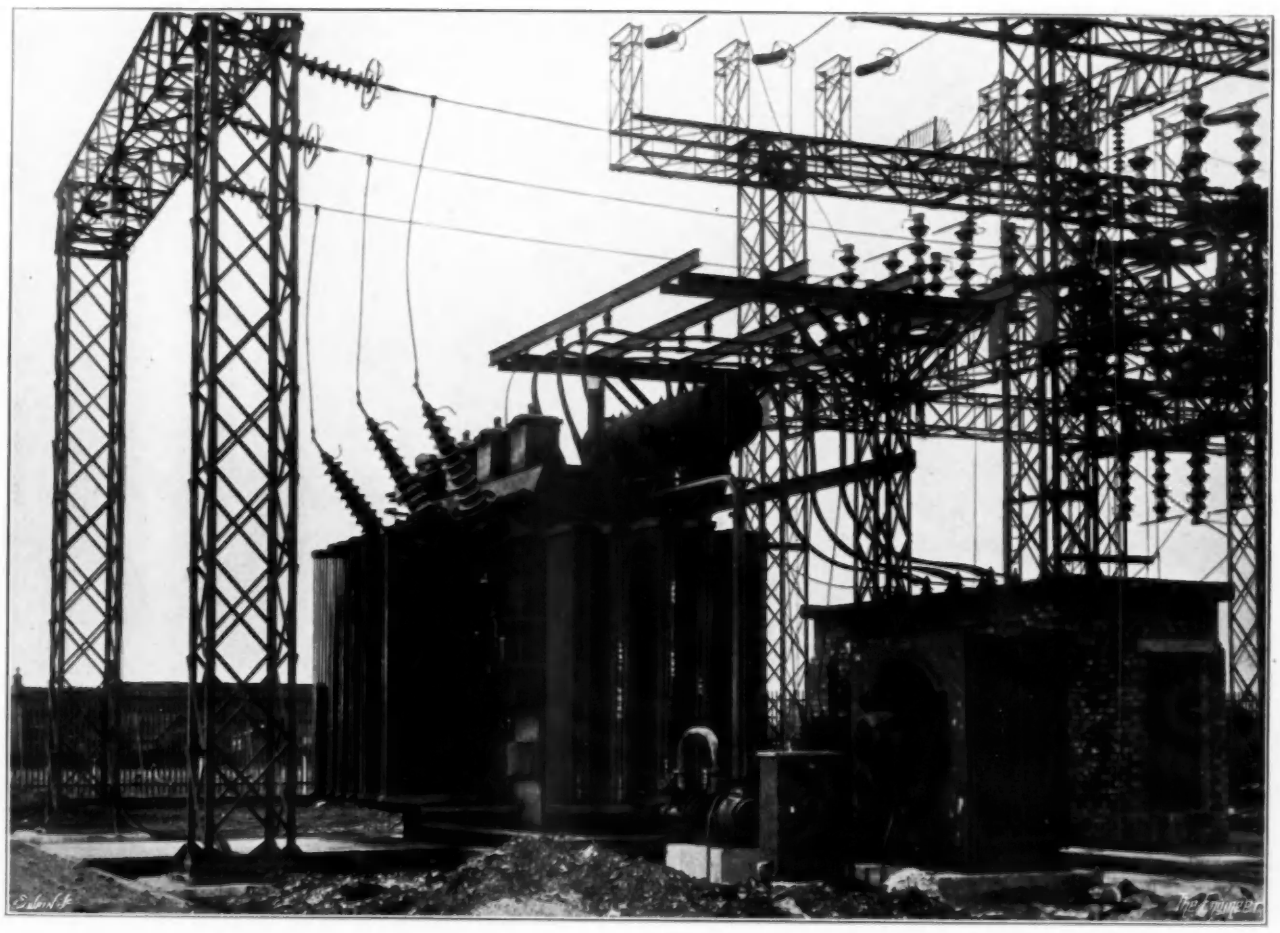
THE KILL VAN KULL BRIDGE, NEW YORK

THE GEORGE WASHINGTON BRIDGE OVER THE HUDSON RIVER

ELECTRICAL ENGINEERING IN 1931

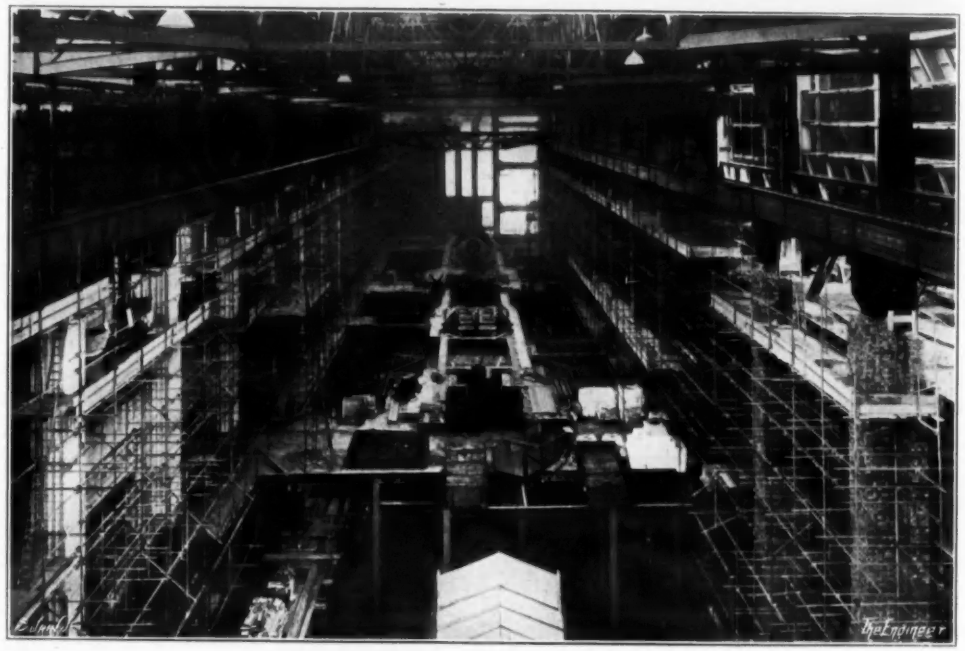


HAMS HALL SUB-STATION—OIL CIRCUIT BREAKERS



HAMS HALL SUB-STATION—45,000-kVA TRANSFORMER AND COOLING PLANT

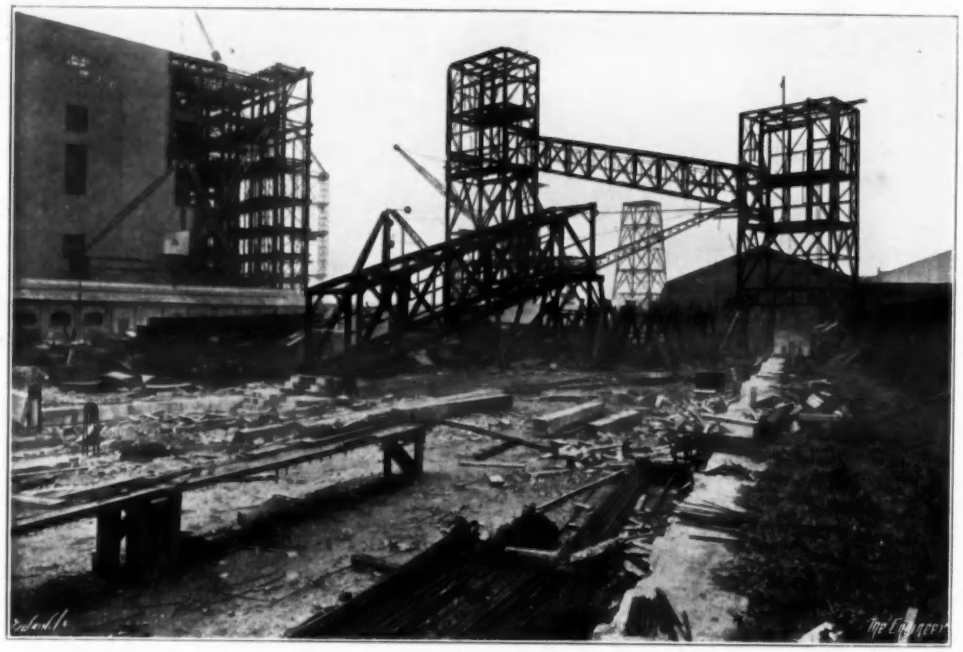
UNIV OF MICH



INTERIOR OF TURBINE ROOM

CONSTRUCTION OF NORTH GABLE END

FLUE-GAS TREATMENT FLUE



CONVEYOR TOWERS

States, and there are also signs that North-East coals are steadily overcoming Polish competition in Northern Europe. The position in the Northumberland steam coal section is quite firm. Virtually all anticipated output for the next ten days is fully earmarked. Good bookings are recorded for all next month's shipments. Hence fitters and other sellers are not pressing on the market. Best steam coals are quoted at 13s. 9d. to 14s., and Tyne primes move steadily at 13s. 3d. There is no improvement to note in the position as regard steam smalls. Best qualities are at 8s. 6d. and ordinary 8s. The gas coal trade is quiet, but fully steady, and the position for later periods is regarded as favourable. Best Durham kinds are firm at 14s. 6d. to 14s. 9d. Secondary gas are steady for prompt, but in good volume forward at 13s. 6d. Coking unscreened are not sought after, and the position is quiet at 13s. to 13s. 9d., with small 12s. 6d. to 13s. 3d. There is well maintained pressure for prompt supplies of gas coke, but makers are heavily sold, and have only odd lots for the next week or two. Best qualities are firm at 19s. Patent oven coke is moving steadily under recent sales, and while sellers offer freely prices retain a firm undertone at 16s. 6d. to 17s. 6d., and for superior make 18s. to 21s.

Contract for Oil-electric Trains.

The first order for the new British oil-electric trains, following the recent successful trials by the London and North-Eastern Railway Company, was announced this week by Sir W. G. Armstrong, Whitworth and Co., Ltd., Newcastle. The order is from the Gaekwar of Baroda's State Railway for four Diesel-electric rail-cars for 2ft. 6in. gauge. The rail-cars are each intended to haul two trailers. Production will start immediately at the Scotswood works. The bodies of the rail-cars are to be built in India to the railway's own requirements.

SCOTLAND.

(From our own Correspondent.)

Overhaul Work.

WITH conditions in the shipbuilding industry in this district in such a state of depression, the arrivals of vessels of the Blue Star Line for overhaul are extremely welcome. A week ago the "Avelona Star" entered the James Watt Dock, Greenock, and the "Rodney Star" has just berthed in the same dock. Internal reconstructions will be carried out in each vessel at an estimated expenditure of some £25,000 in wages. It is said that a third vessel belonging to the same owners is also due shortly for overhaul.

Steel.

The proximity of the New Year holidays has not caused any increase in the demand for steel, and some works may close earlier than usual, and will probably remain inactive for ten days or a fortnight. It is hoped that the accumulation of orders during the vacation will warrant a good re-start. General inquiries have been comparatively good, but the scarcity of orders is pronounced. Sheets are perhaps an exception to the general rule, orders for light descriptions having shown some expansion. Galvanised sheets also share in the movement, but plates, sections, and tubes are poorly specified.

Iron.

The feature this week was the reduction of 10s. per ton in the basis price of bar iron for home delivery, making the quotation £9 15s. per ton for "Crown" quality. This is the first reduction for four years. Business continues slow and the same remark applies to re-rolled steel, which is still quoted £6 7s. 6d. home and £6 5s. per ton export.

Pig Iron.

The output of pig iron in Scotland is still confined to the product of five furnaces, which is ample to meet all requirements. Last week a cargo of 2700 tons from Calcutta and one of 700 tons from Millom arrived at Glasgow Harbour and Bowling respectively.

Scrap.

Scrap remains on the firm level of 40s. to 42s. 6d. for heavy steel and 57s. 6d. to 60s. per ton for cast iron machinery.

Coal.

Owing in a measure to the operation of the quota, the collieries in Scotland, and especially in the Lothians and Fifeshire, have very little fuel to offer for shipment at the end of the year. Consequently shippers had some difficulty in arranging cargoes for ships due to sail before or on December 31st. With the outlook so obscure even early business is difficult to transact, while forward contracting is practically impossible. Total shipments from Scottish ports during 1931 amounted to 10,617,008 tons, showing a decrease of 1,034,360 tons compared with 1930.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Trade and the Outlook.

To attempt a review of the trade conditions in South Wales during the past year would be a doleful task, for a glance backward at the coal industry, iron and steel, ship-repairing, tin-plate, or any other subsidiary trade shows not a single bright spot. It has been a distinctly disappointing period. There have been times when trade appeared to be on the verge of a recovery, but almost as soon as such signs made their appearance they faded out. In the case of the coal industry the conditions have been very unfavourable. Production has been regulated, and minima prices have been in operation. Foreign competitors have, unfortunately for this country, been able to adjust their quotations for business, knowing that prices for British coals cannot be reduced beyond certain levels, and there is no doubt that this country has lost a considerable amount of business. The fact that France and Belgium have instituted the regulation of coal imports has also been disadvantageous. In the case of France, imports of coal were reduced as from the early days of August to 80 per cent. of the average monthly quantities for the three years 1928, 1929, and 1930, while as from the beginning of December the percentage was further reduced to 72 per cent. In addition, the French Government put into operation as from November 12th a surtax of 15 per cent. on coal imports from the United Kingdom, and there is plenty of evidence that this tax has been highly injurious to trade. It cannot be said that the coal export business from South Wales has been good in any direction, except that anthracite has found a good market. Estimating exports for December, it cannot be said that the returns for the whole of 1931 are at all satisfactory. For coal, coke, and patent fuel shipped foreign and coastwise, and as bunkers, the aggregate for 1931 comes to approximately 23,385,000 tons, whereas for 1913 the quantity was 41,378,178 tons, for 1929 31,745,996 tons, and for 1930 29,257,346 tons. Such a falling off in the coal shipment operations has been reflected on the activity of the whole of South Wales. In the shipping industry the rates of freight have been totally uneconomic. While it is true that some local shipowners put some of their tonnage into commission again, it was not because they could see a profit in business, but rather that their losses when running were less than when keeping the steamers laid up. In the iron and steel trade the conditions have been unfavourable, and even now only four blast-furnaces in South Wales are in operation, and these the smaller ones. Ship-repairing has been on quiet lines throughout the year, one reason being that so much of the tonnage trading to this district has been foreign-owned, and owners naturally have, away from their home ports, only had the most meagre repairs effected. Furthermore, the curtailed operations in coal exportation has meant a reduced amount of tonnage trading to local ports, which, of course, has been bad for all associated industries. It has entailed less expenditure at South Wales ports in stores, &c. Enough, in fact, has been said to show that there are no regrets at the passing of 1931, and as regards the future it is quite impossible to predict the prospects, as world-wide financial and economic conditions are much too disturbed. For some months at least it looks as if trade will drag along much as on recent lines. Coalowners and exporters certainly are hoping for some relief from legislative conditions which impose burdens and which cramp freedom in trading operations. An important meeting of South Wales coalowners was held on Tuesday of this week to consider the question of the future of the coal-marketing scheme. It is well known that the Government has invited the opinion of coalowners as to the desirability of continuing the provisions of Part 1 of the Coal Mines Act, 1930, which deals with the establishment of District Boards and of a Central Council for the regulation of coal output and prices.

Coal Industry.

The coal trade has been quiet during the past week or so, and has not yet recovered from the holiday feeling. Last week shipments were, of course, curtailed, and, according to the returns of the Great Western Railway Company, the total came to 338,965 tons, which compared with 487,245 tons for the preceding week and with 275,852 tons for the corresponding period of last year. In the early part of last week there was quite a fair amount of loading pressure, berths, in fact, being difficult to arrange, but on Wednesday there was a considerable exodus of tonnage. On that day fourteen berths were vacant, and on Thursday the number was increased to forty-one. As the result of arrivals of tonnage over the holidays, the position on Monday last was that twenty-five berths were vacant, and only four steamers were waiting at Port Talbot and Swansea. This was an unsatisfactory situation for the recommencement of work after the vacation, and it cannot be said that the immediate outlook is at all good. Very little fresh inquiry from abroad has been received for cargoes of coal for early shipment, and there has been no new development in regard to contract operations, except that in the case of the Egyptian State Railways the Maris Export Company has been allocated the supply of 90,000 metric tons. This company's price was 25s. 6d. per ton, c.i.f. Alexandria, and it is not surprising that some discussion was caused in coal circles when this became known, as when tenders were put in two firms quoted lower prices. It is reported that the railways do not intend to make any further purchases on a c.i.f. basis, but that there is a prospect of their buying round about 30,000 metric tons on a f.o.b. basis.

Bunkering Complaints.

Recently one of the leading Cardiff shipowners made a complaint about the long time taken to bunker a steamer in Barry, compared with the time taken at the Tyne, and since then there has been considerable comment on the whole subject relating to the employment of coal trimmers and their hours of work in this area. It is a recognised fact that South Wales has in the last few years lost some ground in the matter of bunkering of tonnage. The Great Western Railway Company's attitude to the subject is that it has provided the appliances, and it is for the parties concerned to make such arrangements as will get the best use out of them. The coal trimmers are paid by the shipowners, and the contention of most people interested in the question is that it is time there was an alteration in a system in which a dual control prevails. Some leading authorities advocate the abolition of the Clearing House, and suggest that there should be a return to that system under which coalowners and coal exporters had control of the trimmers. In years gone by the coalowners and exporters had their own gangs of trimmers, and there is no doubt that the work done then was better than that done under present conditions. The old system had its drawbacks, no doubt, but these can be remedied. It is also contended that there should be more elasticity in the hours of work. The subject has for some time been under consideration by the South Wales coalowners and the South Wales Coal Shipment Advisory Committee, and both these bodies are convinced of the desirability of a change in the existing system. In the interests of all parties concerned, it is essential that they should get together with the least delay possible to thrash out details so that work can be speeded up and more business attracted to this area.

Anthracite Items.

Considerable interest has been manifested in the movements of Sir Richard Redmayne, formerly His Majesty's Chief Inspector of Mines, who immediately prior to Christmas visited the Swansea Valley, and who, according to all accounts, was due to return there after the holiday vacation. Sir Richard declined to make any statement as to the purpose of his activities, but it is reported that they have to do with a possible amalgamation of a number of independent anthracite collieries. On Christmas Eve at the Cefn Coed Colliery, belonging to the Amalgamated Anthracite Collieries, Ltd., at Crynant, Neath, no less than 1026 tons of anthracite coal were raised from the one shaft which has been equipped for winding. This represents a record for anthracite production. It is only a year ago that the Big Vein, from which the output was obtained, was struck.

Current Business.

Operations have not really settled down since the holidays, but have certainly been very quiet in respect of all classes of coal during the past few days. Extremely little fresh inquiry has come along, and the prospects for the next week or two are by no means favourable. Coke is quietly firm, but there is a very meagre demand for patent fuel. Coke remains round about 24s. 6d. to 25s. 6d.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. HENRY C. ADAMS, M. Inst. C.E., M.I. Mech. E., F.R. San. I., has been elected President of the Institution of Sanitary Engineers for 1932.

MR. ARTHUR J. LEES, the parliamentary agent and secretary of the Urban District Councils' Association, has accepted the position of honorary solicitor to the Association of Consulting Engineers (Incorporated).

NUTS AND BOLTS (DARLASTON), Ltd., of Foster-street, Darlaston, asks us to announce that it has acquired from Evertite Locknuts, Ltd., the sole manufacturing and distributing rights of the "Evertite" nut in Great Britain and certain overseas territory.

MR. R. L. SMITH has decided to discontinue his services with Vickers-Armstrongs, Ltd., with whom he has held the position of chief metallurgist at Erith for the past twenty-two years. He proposes to open an office in the coming year as consulting works metallurgist and inspector.

HENRY LEA AND SON, of Birmingham, ask us to announce that they have purchased the practice of the late Mr. Moffett, practising as Moffett, Rosher and Mann, consulting engineers, of Union Chambers, Birmingham, and that they will deal with all the work involved from their office at 151–153, Edmund-street, Birmingham.

MR. F. S. SINNATT, F.I.C., has been appointed Director of Fuel Research under the Department of Scientific and Industrial Research. Dr. Sinnatt has been Assistant Director of Fuel Research since 1924. Previously he was Lecturer on Fuels in the University of Manchester Faculty of Technology and Director of Research to the Lancashire and Cheshire Coal Research Association.

CONTRACTS.

BROOK MARINE MOTORS, Ltd., of Lowestoft, has received from the Port of Piræus Authorities an order for a batch of that firm's 15/40 H.P. six-cylinder marine motors, for immediate shipment to Greece.

BIRMINGHAM ELECTRIC FURNACES, Ltd., has received an order for thirty-seven electric heat-treatment furnaces of various types for export to Russia. It is believed to be the largest single order for electric furnaces ever placed in this country.

HARLAND AND WOLFF, Ltd., have received an order for the construction of a cargo and passenger steamer for the Bombay Steam Navigation Company, Ltd. The new vessel, which will be about 230ft. in length, will be laid down at the company's Govan Yard.

THE FRASER AND CHALMERS ENGINEERING WORKS (proprietors, the General Electric Company, Ltd.), Erith, has received from the Darlington Rustless Iron and Steel Company, Ltd., an order for a "Bliss" cluster rolling mill. This mill is for the cold rolling of stainless iron sheets up to 48in. wide.

SIR W. G. ARMSTRONG, WHITWORTH AND CO. (ENGINEERS), Ltd., has received an order from the Gaekwar-Baroda State Railways for four Diesel-electric rail cars for 2ft. 6in. gauge. The bodies of the rail cars will be built in India to the railways' own requirements, and the rail cars are each intended to haul two trailers.

THE HACKBRIDGE ELECTRIC CONSTRUCTION COMPANY, Ltd., of Walton-on-Thames, has received from the County of London Electric Supply Company, Ltd., an important order for transformers for installation at the Barking generating station. The order embraces a number of station transformers up to 10,000 kVA capacity and two transformers, each of 93,750 kVA electrical rating, equivalent to 125,000 H.P., three-phase, 50 cycles, 12,500/33,000 volts, B.E.S.A. rating.

INSTITUTE OF METALS: AMERICAN MEETING POSTPONED.—In view of the disturbed economic and financial conditions that prevail in Europe and America, the Council of the Institute of Metals has found it necessary to postpone the 1932 American meeting, which was to have been held in the United States and Canada next autumn. The meeting had been planned with the close co-operation—as prospective hosts—of the American Institute of Mining and Metallurgical Engineers. The Council's suggestion that the meeting be postponed was sympathetically received in America and the assurance has been given that the members will be welcome at such later time as may suit their convenience. An announcement regarding the Institute's place of meeting next autumn will shortly be made.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	17/- to 19/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	16/6 to 17/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 5 6 to 3 6 0	
	3 5 6 to 3 6 0	
No. 1	3 6 0 to 3 6 6	
	3 6 0 to 3 6 6	
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*)	—
	4 0 6 (*b*)	—
	4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 10 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	10 12 6	9 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 15 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 15 0 to 8 0 0	—
Small Re-rolled Bars	6 17 6 to 7 0 0	—
Billets and Sheet Bars	5 7 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 5 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	14/3 to 14/9
Block Tin (cash)	141 2 6
„ (three months)	144 6 0
Copper (cash)	38 10 0
„ (three months)	39 6 0
Spanish Lead (cash)	15 12 6
„ „ (three months)	15 11 3
Spelter (cash)	14 7 6
„ (three months)	14 16 3
MANCHESTER—	
Copper, Best Selected Ingots	42 0 0
„ Electrolytic	48 10 0
„ Strong Sheets	77 0 0
„ Tubes (Basis Price), lb.	0 0 11
Brass Tubes (Basis Price), lb.	0 0 10
„ Condenser, lb.	0 1 0½
Lead, English	17 5 0
„ Foreign	15 15 0
Spelter	14 17 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/4 per lb.	
Ferro Tungsten	2/- per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 12 6	7/-
„ „ 6 p.c. to 8 p.c.	£23 10 0	7/-
„ „ 8 p.c. to 10 p.c.	£22 10 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 0 0	10/-
„ „ „ 1 p.c. carbon	£40 0 0	12/-
„ „ „ 0·70 p.c. carbon	£51 0 0	13/-
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£9 10 0 scale 5/- per unit	
„ „ 75 p.c.	£15 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/9
„ „ Ell	14/6
„ „ Splint	14/3 to 15/9
„ „ Trebles	16/-
„ „ Doubles	13/6
„ „ Singles	10/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/-
„ „ Trebles	16/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/-
Screened Navigation	17/-
Trebles	16/6 to 17/-
Doubles	13/6 to 14/6
Singles	11/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/6 to 12/9
Secondary Steam	12/3
Trebles	16/- to 16/6
Doubles	13/6
Singles	11/-

(8) N.W. COAST— ENGLAND.

Steams	21/-
Household	32/6 to 51/6
Coke	20/- to 21/-
NORTHUMBERLAND—	
Best Steams	13/9 to 14/-
Second Steams	12/- to 12/6
Steam Smalls	8/6 to 9/-
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6 to 14/9
Second	13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD—	Inland.	
Best Hand-picked Branch	26/- to 27/-	—
South Yorkshire Best	24/- to 25/-	—
Derbyshire Best Bright House	20/6 to 21/6	—
Best House Coal	22/- to 23,-	—
Screened House Coal	19/- to 20/6	—
Best Screened Nuts	17/- to 18/-	—
Small Screened Nuts	15/6 to 16/6	—
Yorkshire Hards	17/- to 18/6	—
Derbyshire Hards	17/- to 18/6	—
Rough Slacks	9/- to 10/-	—
Nutty Slacks	8/- to 9/-	—
Smalls	5/6 to 6/6	—

Blast-furnace Coke (Inland) 11/- to 12/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 17/- to 18/-

(9) SOUTH WALES.

CARDIFF—

Steam Coals:

Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	19/- to 27/6
No. 3 Rhondda Large	19/9 to 20/-
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	19/- to 19/6
Pitwood (ex ship)	24/6 to 25/6

SWANSEA—

Anthracite Coals:

Best Big Vein Large	36/- to 38/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/- to 46/6
Beans	28/6 to 32/6
Peas	20/- to 22/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/3 to 8/9

Steam Coals:

Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6: Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Reduced Output.

THE reports of metallurgical companies on the working results of the past year show little indication of what may possibly happen in the coming twelve months, for there is a monotonous tale of falling foreign trade and lessening home consumption which can only be stopped by a general revival of confidence. Before such confidence can be restored there is much to be done, and meanwhile manufacturers see that their hopes must centre in encouraging an international grouping of interests so that production can be controlled and adjusted to consumption, and prices be maintained. In the past such groups have usually failed to work in a spirit of co-operation, and at the meeting of the Steel Cartel held in Paris last week nothing could be done to settle the more difficult problems, notably the quotas, and another meeting is to be held shortly. Now that the situation is becoming steadily worse, every effort is being made to revive the groups under conditions that would enable each country to keep its own market and participate in the foreign trade, and if that arrangement fails there will be no alternative but to apply the import quota system to iron and steel, which, in this country, will practically mean prohibition. A campaign is now being carried out in favour of the State departments, railway companies, local bodies and others purchasing nothing but French iron, steel and engineering products, and it is hoped that the programme of public works will enable producers to make a stand against the persistent trade decline. Something may also be expected from the colonies, and rail makers are particularly anxious to see the Trans-Saharan Railway put in hand, as that undertaking would provide activity to the steel trade and to many branches of engineering; but it and some other big schemes cannot be undertaken lightly during a time of financial depression.

Public Works Inaugurations.

Three important public works were completed in Paris during the past week, when the widened Concorde Bridge was re-opened, the enlarged Est Railway terminus was officially put into service, and the Pont de l'Europe behind the Gare Saint-Lazare was tested and opened to traffic. The Concorde Bridge was constructed in 1791 and had a width of 14·75 m. between the balustrades, and that dimension being no longer sufficient for the traffic, it was decided to increase it to 35 m., which is about the same as that of the Alexander Bridge. That operation was effected by extending the two sides in order to keep the same axis in perspective between the Chamber of Deputies and the Madeleine. The method of carrying out the work has been described in these notes from time to time during the two and a-half years it has been in hand. Beneath the roadway and pavements are twelve conduits for the water, gas, electricity, telephone and sewage mains. It is proposed to widen some of the other bridges which are a cause of traffic congestion. The Est terminus has been made into one of the biggest railway stations in Europe by means of considerable extensions and partial reconstruction, and at the same time the railway outside the station has been widened to avoid the difficulties and danger of the bottle-neck that formerly existed there. The extended frontage keeps to the original style, but the rest is entirely modern in design and construction, with a primary regard to space and light and the free movement of passengers. In the main hall there is being installed the first locomotive that ran between Paris and Strasburg. At the opening it was pointed out that, while in 1910 the number of passengers carried on the Est Railway was 12 millions, that number had increased in 1930 to 26 millions, owing mainly, of course, to the extensive works that have been carried out since the war to facilitate traffic with the restored provinces of Alsace-Lorraine. The work upon the Pont de l'Europe has also been described in these notes. It is a star-shaped bridge over the railway behind the Gare Saint-Lazare, which connects five streets converging thereto. It replaces an old iron structure on a number of piers which obstructed the view, and the metal work of which had undergone so much corrosion that it had to be removed. The different sections of the new bridge were assembled on falsework and lowered to the reinforced concrete piers, and the bridge itself is entirely encased in concrete and faced with enamelled tiles underneath where exposed to the smoke and fumes of locomotives. The work lasted three years and did not interfere with the train services in any way.

Port of Pointe-Noire.

Since the Government of French Equatorial Africa was authorised to raise a loan of 300 million francs for the carrying out of public works, and particularly the railway between Brazzaville and Pointe-Noire on the coast, the work of building the new port is being pushed forward. It is a remarkable enterprise, which aims at making a great port on the short stretch of coastline that offers the only outlet to the sea from the Central African colony and possesses no natural facilities for shipping. At Pointe-Noire there is a coastal belt with swamps behind and a spit of land which has to be extended by a mole to reach deep water. As this is the terminus of the Brazzaville Railway the plans for the port provide for a traffic in the more or less distant future of something like 2,000,000 tons a year, but for the moment the works are being carried out for a modest 150,000 to 200,000 tons a year, and they consist of a reinforced concrete wharf with eight portal cranes and two fixed cranes of 20 tons, and Customs' and other buildings. A town laid out on the most improved lines has grown up, water is obtained from a lake 9½ miles distant by a 13in. main, and ships are supplied from a water tank which is floated out to the anchorage. How far the scheme to make Pointe-Noire a port second only to Dakar can be carried out depends upon some more definite knowledge of future traffic and also upon the financial aspect of the undertaking, for all material and everything for construction has to be conveyed to Pointe-Noire at great expense and the work will be very costly.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

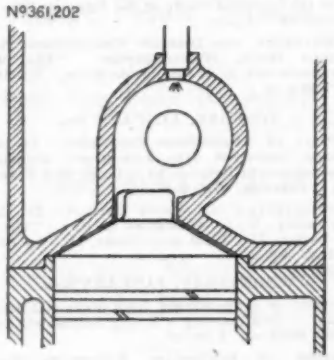
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

361,202. February 5th, 1931.—COMBUSTION CHAMBERS, F. C. Russell, Grosvenor-road, Altrincham, and J. H. Bradbury, "Allanville," Doveston-road, Ashton-on-Mersey.

This invention relates to internal combustion engines of the kind having a combustion chamber into which an air charge is compressed by the piston and into which charge the combustible fluid is injected. The invention relates more particularly to such engines wherein the combustion chamber is off-set and the piston is provided with an extension adapted to enter a passage between the cylinder and combustion chamber, so as to form a restricted passage through which the last portion of the air charge is injected at a higher velocity, creating an accelerated revolution of the charge in the combustion chamber to assist combustion. Hitherto in such engines the restricted passage for the final air injection has, says the inventor, been positioned in the central plane of revolution of the gases in the chamber, and the fuel has been injected so as to meet or enter the accelerated portion of revolving air thus produced. According to the invention two restricted air injection passages are provided forming two separate zones of high-speed revolution, the chamber is formed with inwardly convex ends and the fuel is injected between the two said zones of revolving air and towards the centre of the chamber. The invention is based upon careful observation of internal combustion engines of the type of which the invention is an improvement, from which it was believed that the use of a revolving air charge in the combustion chamber, while itself being an improvement, had the result of establishing, as it were, three zones within the combustion chamber. These zones were: (a) a slow-speed,

N°361,202



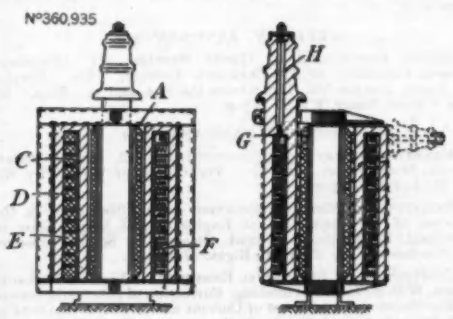
high-pressure dense outer zone, its speed being reduced by the scrubbing action against the walls of the chamber; (b) an intermediate higher speed zone of moderate pressure, and (c) a central pocket or core in which there is the highest temperature, but slowest motion. It was believed that the air in the outer zone was not being properly utilised, the fuel not breaking through into the dense mass of the high-pressure zone, and that the velocity of the accelerated portion of the zone (b) was causing the fuel to be thrown against the dense zone, preventing it from mixing therewith. The features of the present invention are provided to meet these deductions. In the first place, the divided injections, of which there will usually be two, are respectively placed near the side walls of the chamber, where they have the effect of rupturing the high-pressure zone (a). The convex side walls of the chamber reduce the pocket or core (c) and concentrate and control the high-temperature vortex therein. The fuel injection between the divided accelerated portions of the intermediate zone enables the fuel to mix with the ruptured high-pressure zone, and also avoids contact of the fuel with the walls of the chamber. The passages may be formed in the extension of the piston, or in the cylinder passage or partly in the extension of the piston and partly in the cylinder passage. The exact position and direction of injection of the fuel appears to have little effect on the efficiency of the combustion, providing it is between the accelerated parts of the intermediate zone. If brought to one side or the other the exhaust shows signs of incomplete combustion. With the improved construction, an engine having only the altered combustion space showed an increase of 15 per cent. brake horse-power resulting from a higher brake mean effective pressure. The engine also ran cooler and cleaner.—*November 19th*, 1931.

TRANSFORMERS AND CONVERTERS.

360,935. July 10th, 1930.—HIGH POTENTIAL TRANSFORMERS, Koch und Sterzel Aktiengesellschaft, of Zwickauerstrasse, 40–42, Dresden—A. 24, Germany.

A potential transformer constructed in accordance with this

N°360,935



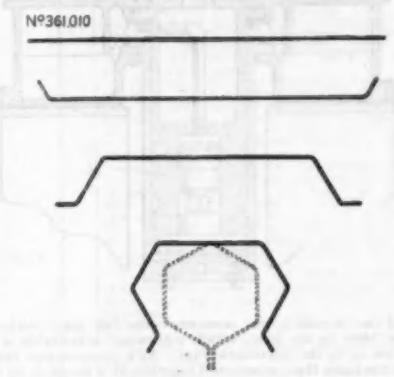
invention has a L.T. winding A surrounding the core. The core supports a single part insulating trough with walls C and D. In this trough there are coils E in the form of discs and between each coil there is an insulating disc mounted on an insulating tube F, so that the complete high potential winding may be assembled outside the insulating body and subsequently inserted therein. The beginning of the high potential winding is connected to the iron core, which is earthed, whilst the other end of the winding is connected to the metallic conductor G, which in turn is connected to a lead H, extending through the insulator. The conductor G is preferably in the form of a split ring at the base of the trough and constitutes an end winding. If desired, the insulator may project at the side of the transformer, as shown dotted. The walls of the trough containing the H.T. windings may be tapered so that they increase in thickness in accordance with the increase in potential of the winding.—*November 10th*, 1931.

AERONAUTICS.

361,010. August 26th, 1930.—METAL SPARS, Petters Ltd., Yeovil.

This invention is concerned with the fabrication of spars, for aeroplane construction, from sheet metal, and it is explained that if a tapered spar is required, two such spars can be cut from

N°361,010

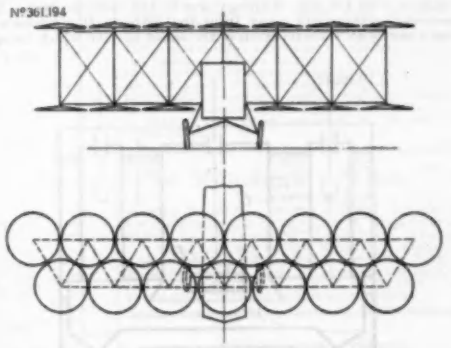


a rectangular sheet of material by means of a diagonal cut. Having been cut out the material is folded, by means not disclosed, to make a hollow spar. It is suggested that the angles of the folds are preferably greater than a right angle. The sketches show some of the processes in the formation of a spar.—*November 19th*, 1931.

361,194. January 31st, 1931.—AEROPLANES, Zdenko Janak, Arbesovo nam. 7, Prague XVI., Czecho-Slovakia.

The inventor claims that the adoption of his system of sustaining surfaces reduces the head resistance, increases the carrying

N°361,194



power and enables landing to be effected more safely than heretofore. The essence of his idea is that the wing surface should be made up of a multiplicity of discs, which are rotated by the action, on vanes attached to them, of the draught caused by the forward movement of the machine.—*November 19th*, 1931.

FURNACES.

360,288. February 2nd, 1931.—A RECTIFIER SYSTEM FOR FEEDING ELECTRIC ARC FURNACES FROM ALTERNATING CURRENT, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

A method is described in this specification of operating a number of arc furnaces fed in parallel from a common transformer through rectifiers. A and B are arc furnaces working in

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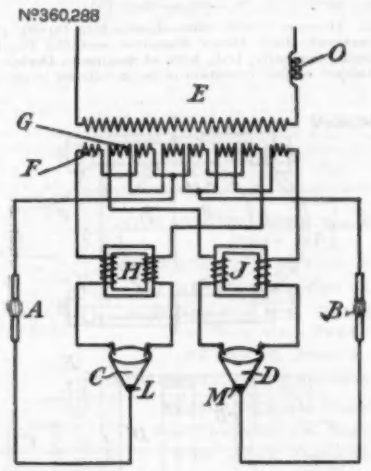


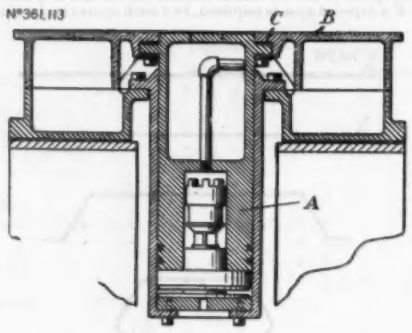
parallel, fed through the rectifiers C D from the common transformer E. The transformer has two secondary windings F G, which are subdivided and are intimately intermixed on the common transformer limb opposite the primary winding. Each of the secondary windings feeds a rectifier, the end terminals of the secondary windings being connected over the interlinked choking coils H J to the associated rectifier anodes. The centre points of the secondary windings are connected to the electrodes

of the arc furnaces, the other electrodes being connected to the cathodes L M of the rectifiers. A steadying choke O is preferably interposed in the primary circuit of the feeding transformer. The interlinked choking coils are so designed that, in the case of contact being established between the electrodes of one furnace—that is to say, in the case of a short circuit—they can take up the full voltage of the secondary winding without the magnetising current assuming a value which would endanger the operation of the other furnace.—*November 5th*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

361,113. November 18th, 1930.—MOULDING MACHINES, F. R. Wallace, Philadelphia, Pennsylvania.

This invention is concerned with foundry moulding machines of the jarring type, in which a table carrying the flask is raised pneumatically and allowed to fall abruptly on to a base, so as to jar the sand in the flask into solid compact. It is suggested

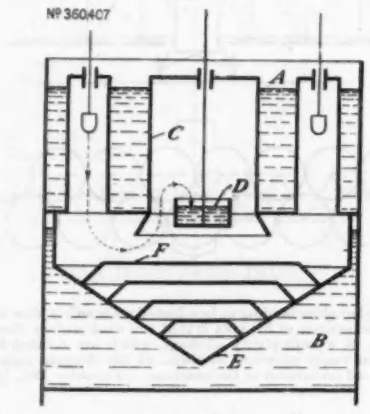


that if the mould is not concentric the fall may produce an uneven blow on the base, which will cause undesirable stresses to be set up in the pneumatic ram. As a consequence, the ram A and the table B are connected together by a flange C, on either side of which there are washers of resilient material, such as ebonite oil-proof rubber, which permit of a certain degree of displacement between the table and the ram.—*November 19th*, 1931.

MISCELLANEOUS.

360,407. May 30th, 1930.—MERCURY-VAPOUR ELECTRIC DISCHARGE DEVICES WITH TWO COOLING SYSTEMS, Friedrich Lutz, of Sulgenauweg 32, Berne, Switzerland.

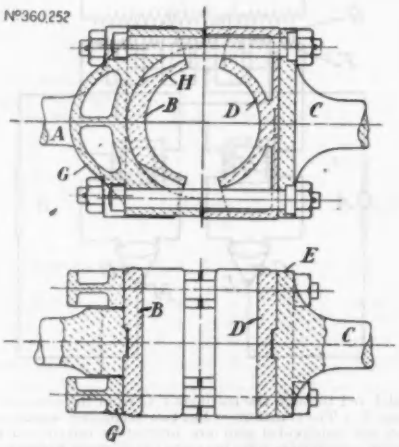
A mercury arc rectifier constructed in accordance with this invention has two coolers A and B. The former surrounds the anode arms and the condensation dome C, and it deals almost entirely with the loss of energy due to the cathode drop. The mercury evaporating away from the cathode D condenses in the dome, with the exception of the small portion which escapes



downwards. The condensate of the dome is returned to the cathode by a centering device, which is not shown. The main portion of the energy loss corresponding to the anode drop and the voltage drop in the anode arms is also dealt with by the upper cooler. A small portion of this loss is radiated away in a downward direction to the bottom plate E, the energy dissipated in the lower cooler being relatively small. Screens for guiding the mercury vapour are provided at F. In the case of fresh-water cooling, the water is first supplied to the cooler B and then to the cooler A.—*October 30th*, 1931.

360,252. December 22nd, 1930.—LARGE END CONNECTING-ROD BEARINGS, John Henry Hamilton and the Premier Gas Engine Company, Ltd., both of Sandiacre, Derby.

The object of this invention is to provide an improved con-



struction of big end bearings of engines, pumps and compressors, and more particularly to the type in which the connecting-rods of two opposed pistons have a common bearing upon a common crank pin. The connecting-rod A is secured by bolts to the part B constituting one-half of the bearing. The width of the foot of the connecting-rod which is connected to the part B is about one-half the axial length of the bearing which projects an equal amount beyond this foot at its opposite sides, as shown in the lower drawing. The outside of each projecting part of the bearing B beyond the sides of the foot is made concentric with the bearing. The other connecting-rod C has the half bearing D associated therewith, but in this case the connecting-rod foot E is of the same width as the bearing. Bolts pass through the connecting-rod foot E, the half bearing D and bearing pieces G which embrace the projecting ends of the half bearing B, there being two bolts through each bearing piece G. The faces of the parts B and D are, of course, lined with bearing metal, as are also the wearing faces of the bearing pieces G. The projecting ends of the bearing piece B are cut away at opposite sides at H to clear the bolts, as the connecting-rods vary in their angular relationship during the movements of their pistons.—*November 6th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Photogravure and the Intaglio Press," by Mr. B. A. Gooderham. 7.30 p.m.

SATURDAY, JANUARY 2ND.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Christmas Lecture, "The Universe of Light"; Lecture III., "Light and Colour, I.," by Sir William Bragg, F.R.S. 3 p.m.

MONDAY, JANUARY 4TH.

SOCIETY OF CHEMICAL INDUSTRY: LONDON SECTION.—In the Chemical Society's Rooms, Burlington House, W. 1. "Recent Progress in the Chemical Study of the Vitamins," by Professor J. C. Drummond. 8 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOCIETY.—The Victoria Hotel, Wolverhampton. "The Mechanical Principles Embodied in Weighing Machines," by Mr. W. A. Benton. 7.30 p.m.

TUESDAY, JANUARY 5TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2, "Oil Consumption in Relation to Cylinder and Piston Wear," by Mr. E. C. Ottaway. 7.45 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Christmas Lecture, "The Universe of Light, Lecture IV., Light and Colour, II.," by Sir William Bragg, F.R.S. 3 p.m.

WEDNESDAY, JANUARY 6TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Birmingham. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "Multi-channel Television," by Mr. C. O. Browne. 6 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Swedenborg Hall, 20, Hart-street, Bloomsbury, W.C. 1 (entrance in Barter-street). "Coal Gas as a Fuel for Hot Water Supply and General Heating," by Mr. E. L. Oughton. 7 p.m.

THURSDAY, JANUARY 7TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Merchant Venturers' Technical College, Bristol. "Epicyclic Gearing," by Major W. G. Wilson. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—In the Chamber of Commerce, Birmingham. "The Underpinning of a Heavy River Wall," by Mr. Wm. Muirhead. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—In the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. "Methods and Equipment in Cable Telegraphy," by Messrs. H. Kingsbury and R. A. Goodman. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Christmas Lecture, "The Universe of Light, Lecture V., Light from the Sky," by Sir William Bragg, F.R.S. 3 p.m.

FRIDAY, JANUARY 8TH.

ILLUMINATING ENGINEERING SOCIETY.—At the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. "Motor Car Headlights," by Mr. E. S. Calvert. Discussion 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, St. James's Park, London, S.W. 1. Thomas Lowe Gray Lecture, "Modern Types of Propelling Machinery for Mercantile Marine Use," by Mr. Sterry B. Freeman. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Refrigeration: Modern Practice and Practical Calculations," by Mr. B. C. Oldham. 7.30 p.m.

RAILWAY CLUB.—57, Fetter-lane, E.C. 4. "Further Problems of Passenger Train Operation," by Mr. C. R. Clinker. 7.30 p.m.

SATURDAY, JANUARY 9TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Christmas Lecture, "The Universe of Light, Lecture VI., Light from the Sun and the Stars," by Sir William Bragg, F.R.S. 3 p.m.

MONDAY, JANUARY 11TH.

CHARTERED SURVEYORS' INSTITUTION.—12, Great George-street, Westminster, S.W. 1. "The Genius of Wren," by Mr. P. W. Lovell. 8 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Some Properties of Fire-bricks," by Mr. H. C. Biggs. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Victoria Embankment, W.C. 2. Informal meeting. Correction of title to discussion. "The Relative Importance of Current and Installation Costs as Affecting the Sale of Electricity," opened by Mr. H. T. Young.

TUESDAY, JANUARY 12TH.

INSTITUTE OF MARINE ENGINEERS.—The Minories, London E.C. 3. "Bilge Pumping in its Relation to Safety at Sea," by Mr. E. F. Spanner. 6 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "Stainless Steel," by Mr. J. H. G. Monypenny. 7 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Discussion on "Defects in Non-ferrous Castings," by Messrs. R. Dowson, S. G. Homfray and A. Logan. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Graduates' Meeting, Watergate House, Adelphi, W.C. 2. "Carburisation," by Mr. E. W. Knott. 7.25 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. "A Review of the Piston and Cylinder Assembly in Relation to Oil Consumption," by Mr. E. C. Ottaway. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Hotel Metropole, Leeds. "Two Transmission Line Problems," by Mr. P. J. Ryle. 7 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. "Modern Methods of Steel Bridge Manufacture," by Mr. J. Thomson. 7.30 p.m.

THURSDAY, JANUARY 14TH.

INSTITUTE OF MARINE ENGINEERS: JUNIOR SECTION.—The Minories, London, E.C. 3. "The Care and Maintenance of Marine Diesel Engines," by Eng.-Lieut.-Comr. H. S. Humphreys, R.N. (retd.). 7 p.m.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—In the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. "X-Ray Examination of Alloys," by Mr. G. D. Preston. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—In the Chamber of Commerce, Birmingham. Vernon Harcourt Lecture, "The Mechanical Handling of Coal at Ports," by Mr. N. G. Gedye, 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: YORKSHIRE BRANCH. Hotel Metropole, Leeds. Annual General Meeting. "Recent Developments in the Treatment of Boiler Water," by Dr. A. W. Chapman. 7.30 p.m.

FRIDAY, JANUARY 15TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Stresses in Metals," by Mr A. Wragg. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, St. James's Park, S.W. 1. Informal Meeting. Discussion on "Industrial Conditions in Russia," introduced by Mr. J. Fearn. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The Development of the Loud Speaker," by Mr. H. J. N. Riddle. 7.30 p.m.

MONDAY, JANUARY 18TH

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Epicyclic Gearing," by Major W. G. Wilson. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Thomas Gray Lecture, "Life Saving Appliances on Merchant Ships" (Lecture I.), by Captain O. A. Barrand and Mr. G. A. Green. 8 p.m.

TUESDAY, JANUARY 19TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineering Club, Queen-street, Wolverhampton. "A Review of the Piston and Cylinder Assembly in Relation to Oil Consumption," by Mr. E. C. Ottaway. 7.30 p.m.

WEDNESDAY, JANUARY 20TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS: BIRMINGHAM CENTRE.—Room 178, Queen's Hotel, Birmingham. "Road and the Road Roller," by Mr. C. G. Miller. 6.45 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2 "Some Aspects of the Problem of Industrial and Commercial Waste," by Mr. J. L. Hodgson. 8 p.m.

THURSDAY, JANUARY 21ST.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "Electric Welding of Non-ferrous Alloys," by Dr. A. Burstall. 7 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—Hotel Metropole, Leeds. "The Employment of Structural Engineers as Specialists," by Mr. W. T. Cresswell. 7 p.m.

FRIDAY, JANUARY 22ND.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Hotel Metropole, Leeds. "Progressive Methods Applied to a Modern Shop for Electric Rolling Stock," by Colonel E. Graham. 7.15 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Notes on Hydraulic Installations in New Zealand," by Mr. H. S. Lamburd. 7.30 p.m.

MONDAY, JANUARY 25TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. Thomas Gray Lecture, "Life Saving Appliances on Merchant Ships" (Lecture II.), by Captain O. A. Barrand and Mr. G. A. Green. 8 p.m.

TUESDAY, JANUARY 26TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Empire Timbers," by Major J. R. Cosgrave. 4.30 p.m.

WEDNESDAY, JANUARY 27TH.

BRITISH WOOD PRESERVING ASSOCIATION.—In the Lecture Hall, Auctioneers' and Estate Agents' Institute, 29, Lincoln's Inn-fields, London, W.C. 2. "Diseases of Timber," by Mr. K. St. G. Cartwright. 6 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Metropole Hotel, King-street, Leeds. "A Review of the Piston and Cylinder Assembly in Relation to Oil Consumption," by Mr. E. C. Ottaway. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineers' Club, Manchester. "Transmission," by Mr. L. H. Pomeroy. 7 p.m.

MONDAY, FEBRUARY 1ST.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Life Saving Appliances on Merchant Ships" (Lecture III.), by Captain A. O. Barrand and Mr. G. A. Green. 8 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOCIETY.—The Victoria Hotel, Wolverhampton. "Waste Heat Boilers," by Mr. F. Jones. 7.30 p.m.

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